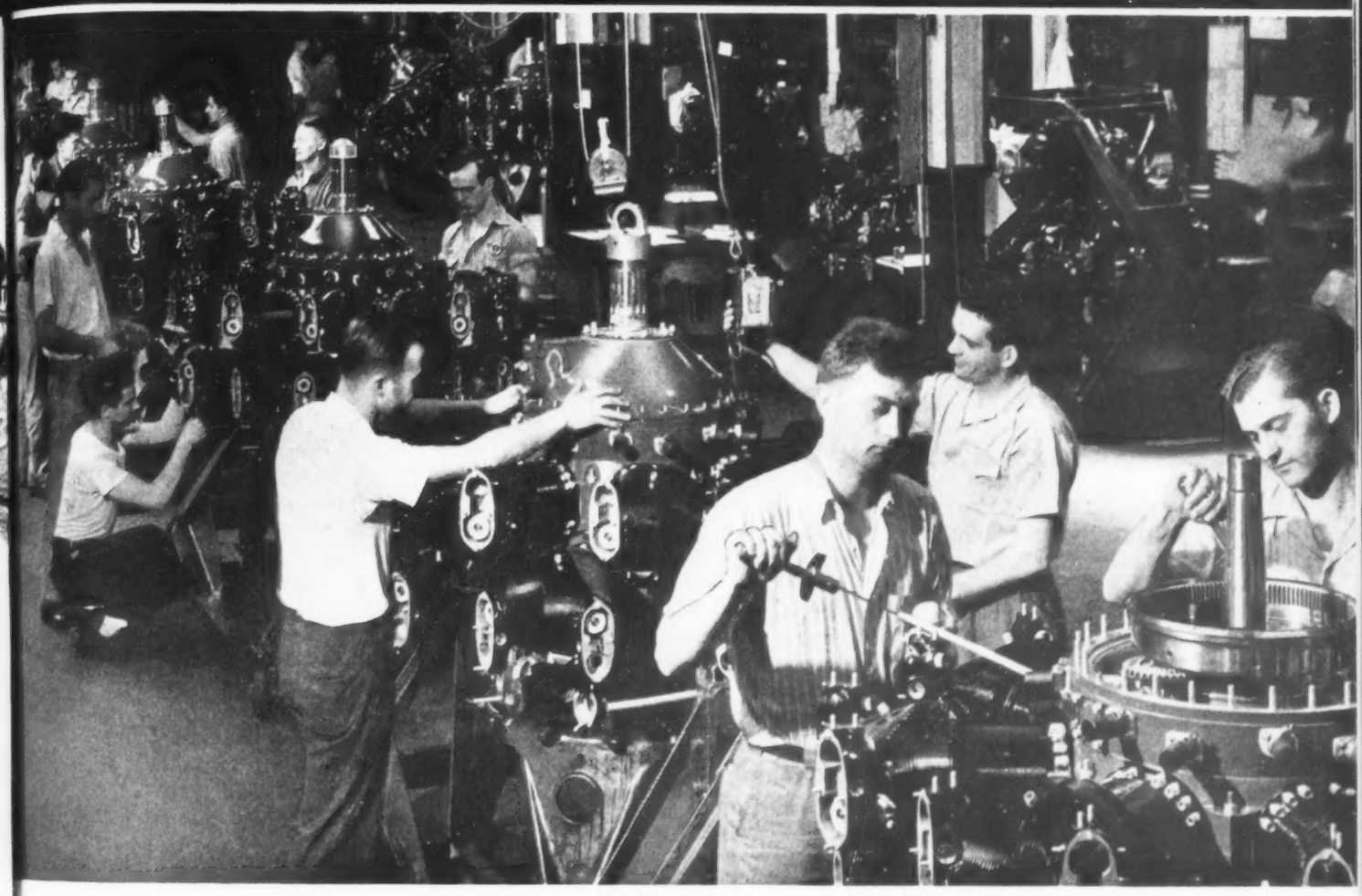
MACHINERY

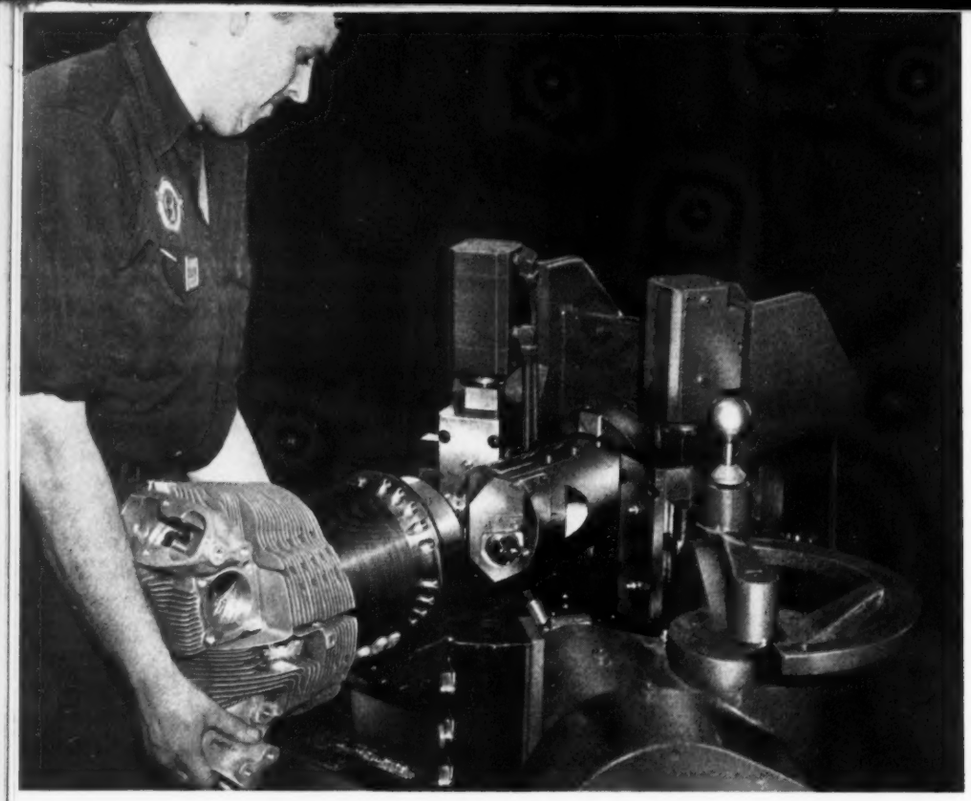
Volume 48 NEW YORK, FEBRUARY, 1942 Number 6



Automatic Tooling Speeds Production in the New Wright Aero Plant

By H. E. LINSLEY
The Wright Aeronautical Corporation

IN response to the unending call for more and more aircraft engines, the Wright Aeronautical Corporation has recently placed in operation the largest single-story factory ever constructed in the United States. Designed expressly for mass production work, this huge plant features the very latest in high-output machine tools. Heretofore, it has not been considered practical, nor indeed possible, to employ fully automatic mass-production equipment for aircraft engine manufacture, on account of the limited production. Today, however, even though quantities are small, compared with normal automobile production, it has been possible to install the type of machines previously found only in automobile factories, and thus to place the aircraft engine on a mass-production basis without sacrificing the extreme accuracy required.



AUTOMATIC

Fig. 1. Special Machine which Performs Chamfering and Back-counterboring Operations on the Spark Plug Inserts of Cylinder Assemblies in One-twelfth the Time Formerly Required

As in the case of any suddenly expanded industry, the greatest difficulty lay in obtaining an adequate supply of skilled labor, and although training schools were set up far in advance of production dates, it was realized that by far the greater part of the productive work would necessarily have to be performed by unskilled, or at best, only partly skilled men. For this reason, then, particular care was taken to see that, in so far as possible, the skill and accuracy would be built into the machine itself, thus leaving the operator little else to do than simply loading and unloading the machine. Such fully skilled men as were available were naturally employed for supervision and for the highly intricate set-up work required.

Typical of the way in which skill has been built into the machines is the Snyder machine shown in Fig. 1, which is one of a number built for countersinking and spherical back-counterboring the two spark plug bushings in cylinder assemblies. The cylinder assembly is located over an arbor, endwise location being obtained from the face of the cylinder hold-down flange. Swinging toe-clamps, hydraulically operated, are used for clamping.

The end milling cutters used are equipped with four tungsten-carbide tipped blades for forming, and two for countersinking, and are carried in slides mounted inside the arbor. They are hydraulically fed into the work by cam-bars, which pass through the arbor to the cutter-slides and are connected at the rear to a bracket carried on the piston-rod of the hydraulic cylinder. Rotation of the cutters is obtained through two quill spindles, which have square ends that engage square holes in the end of the cutters.

After the part has been located and clamped, the spindles are advanced by hand until they engage the cutters. The machine is then started, and the cutters are fed into the work hydraulically until the proper depth is attained, this being assured by an adjustable positive stop. The cutters are then automatically retracted from the work and the spindle-drive motors are stopped by solenoid-operated brakes, after which the spindles are backed out of the cutters by hand, and the part is unloaded. The floor-to-floor time on this machine is only 55 seconds per part as against 11 minutes when the operation was performed on a single-spindle back spot-facing machine of standard design.

On the same part—the cylinder assembly—twenty holes are drilled, reamed, and countersunk in the hold-down flange on special Baker vertical, hydraulic-feed, forty-spindle, five-station indexing machines of the design illustrated in Fig. 2. Parts are loaded at the first station, and then indexed to Station 2, where ten 29/64-inch diameter holes are drilled. At the next station, ten more holes are drilled, and at the remaining stations these holes are combination reamed to a diameter of 0.4685 inch and countersunk 45 degrees to 0.510 inch diameter. The operating time has been reduced by the use of this machine from 6.1 minutes to 1.5 minutes per part. All stations operate simultaneously, so that after the machine has made one full circuit, a finished part is delivered with each indexing of the table.

Of outstanding interest are two types of

Greenlee machines used on steel crankcases. The one shown in Figs. 3 and 4 is a six-way, horizontal, seven-station automatic indexing machine for drilling and back-counterboring the twenty cylinder hold-down screw-holes in each of fourteen pads. The crankcases are loaded over a vertical locating post equipped with rubbing strips to avoid damaging the main bearing, final location being obtained by hardened steel blocks fitting into the ground inside diameter of the crankcase. A cover plate with a swinging U-washer fits over the top of the locating post and is held down by a large nut. When the machine is started, the first and fourth heads alone operate, each drilling ten holes 0.368 inch in diameter. After the first indexing, the second and fifth heads also operate, each back-counterboring five holes to 0.470 inch diameter with a 0.030-inch radius in the corner. After the next indexing, the third and sixth heads come into use, each back-counterboring five holes. When the cycle is complete and all twenty holes have been finished in each of the seven pads of the lower row, the crankcase is turned over on the fixture, and located on the outside of the flange; the second row of pads is then similarly drilled and back-counterbored.

The operation of the back-counterboring tools is highly ingenious. The tool bits are mounted in sliding holders in such a way that they are normally off center sufficiently to permit them to pass through the drilled holes. When the head is fully advanced, the tools move transversely until they are on center before beginning to rotate. The entire head then feeds backward until the counterbores are at the proper depth, whereupon the tools again move crosswise to permit their withdrawal from the holes.

The Greenlee four-way, horizontal, seven-station, automatic indexing machine shown in Figs. 5 and 6 is used for combination reaming and countersinking, and tapping the same holes. Locating is accomplished the same as on the drilling and back-counterboring machines, but in order to avoid distortion, the clamp is fitted with a special wrench that permits only sufficient pressure to be applied to prevent the part from moving. The first and third heads combination ream to from 0.394 to 0.396 inch diameter and countersink at a 90-degree included angle to 0.450 diameter, while the second and fourth heads tap threads of 0.438 inch diameter, 20 threads per inch, using a lead-screw to insure proper lead and accuracy.

On both of these machines, massive spindles and a short overhang insure great rigidity and extreme accuracy. Each head is equipped with its own coolant supply to each individual tool, as seen in Fig. 5, and the arrangement is such that coolant flows only when the tools are in the cutting position. The feeds are hydraulic, and the electrical and hydraulic systems are so arranged that each head must complete its full cycle before indexing can take place. Furthermore, each cycle must be completed in its proper order; if, for example, the part were indexed by hand so as to upset this order, the machine would refuse to operate until the proper order was restored.

High-production equipment of this type is naturally expensive, but when it is realized that one machine such as shown in Fig. 4 takes the

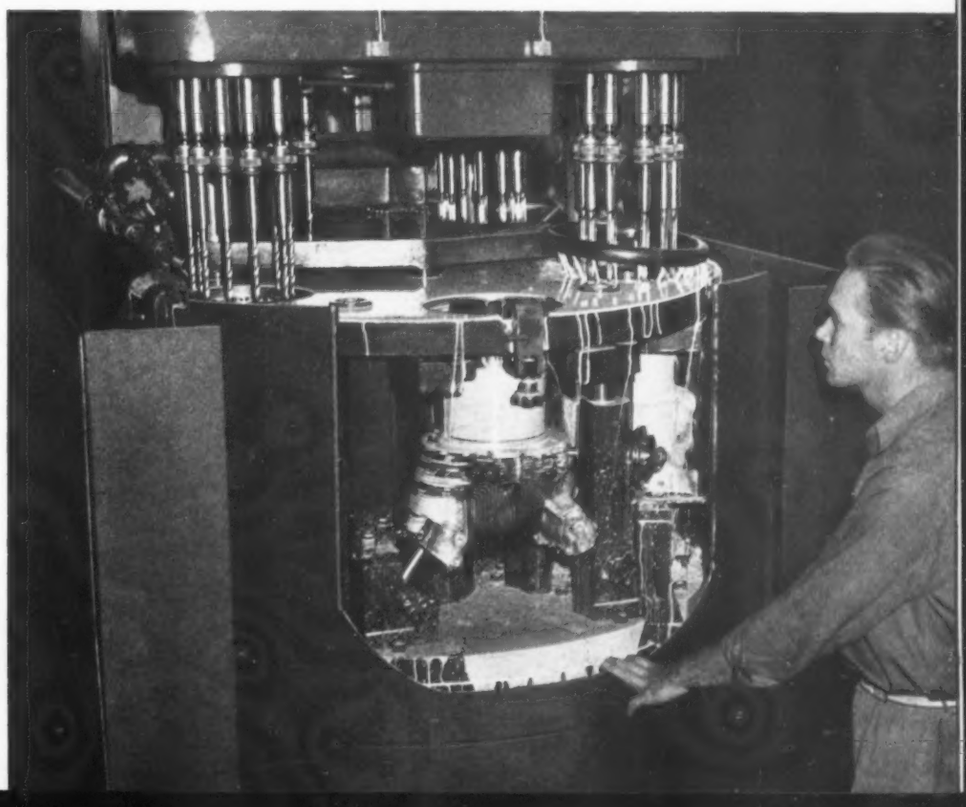


Fig. 2. Machine Designed for Drilling, Reaming, and Countersinking the Twenty Holes in Cylinder Assembly Flanges with a Saving in Time of 75 Per Cent, as Compared with Previous Methods

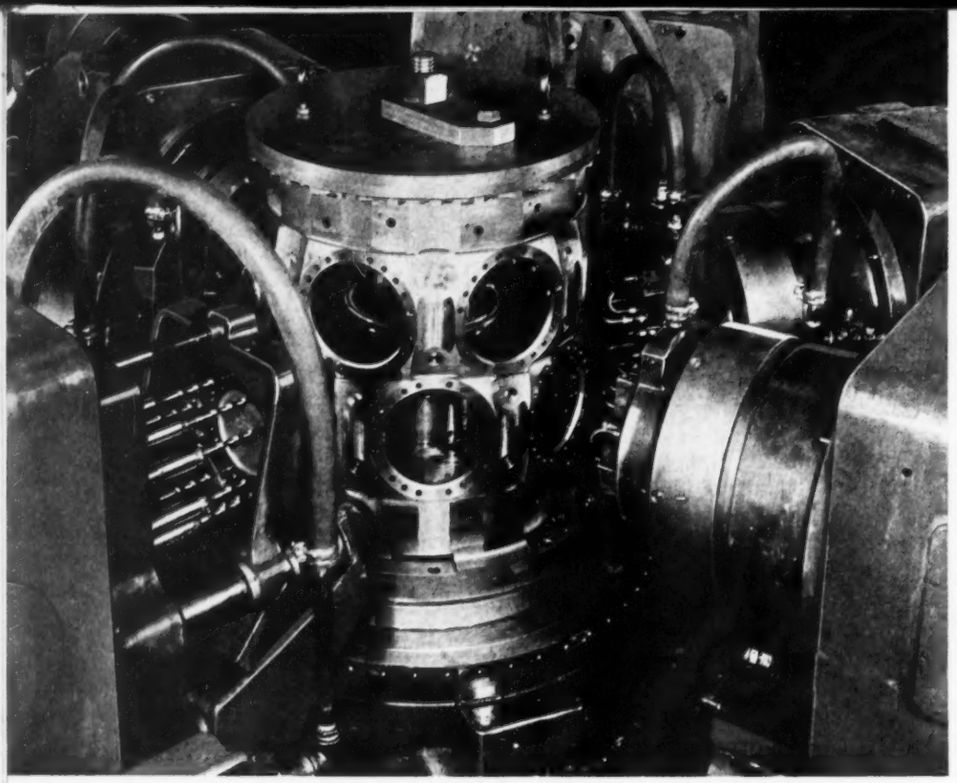


Fig. 3. Close-up View of the Machine Shown in Fig. 4, which is Used for Drilling and Spherical Back-counterboring 280 Screw-holes in Each Crankcase

VICTORY

place of five semi-production machines required to give an equivalent output, it is evident that there is a substantial saving in machine costs alone, without taking into consideration the fact that nine less men are required per day. Machines of the type illustrated in Fig. 6 show amazing savings, since one such machine takes the place of thirteen machines previously required, and actually costs less than half their total cost, while there is also a direct saving in labor of thirty-six men a day.

The machining of the twenty trunnions that project from the face of reduction gear carrier rings is now performed on special Heald "Bore-Matics" equipped with two cutting heads in the manner shown in Fig. 7. The parts are loaded on an indexing head, which advances by a rapid hydraulic movement to the feed position. Two diametrically opposite trunnions are then fed into tungsten-carbide tipped, adjustable-blade hollow mills which turn the outside diameter and face the shoulder. When finished, the work-head withdraws and indexes automatically to bring the next two trunnions in line with the cutters.

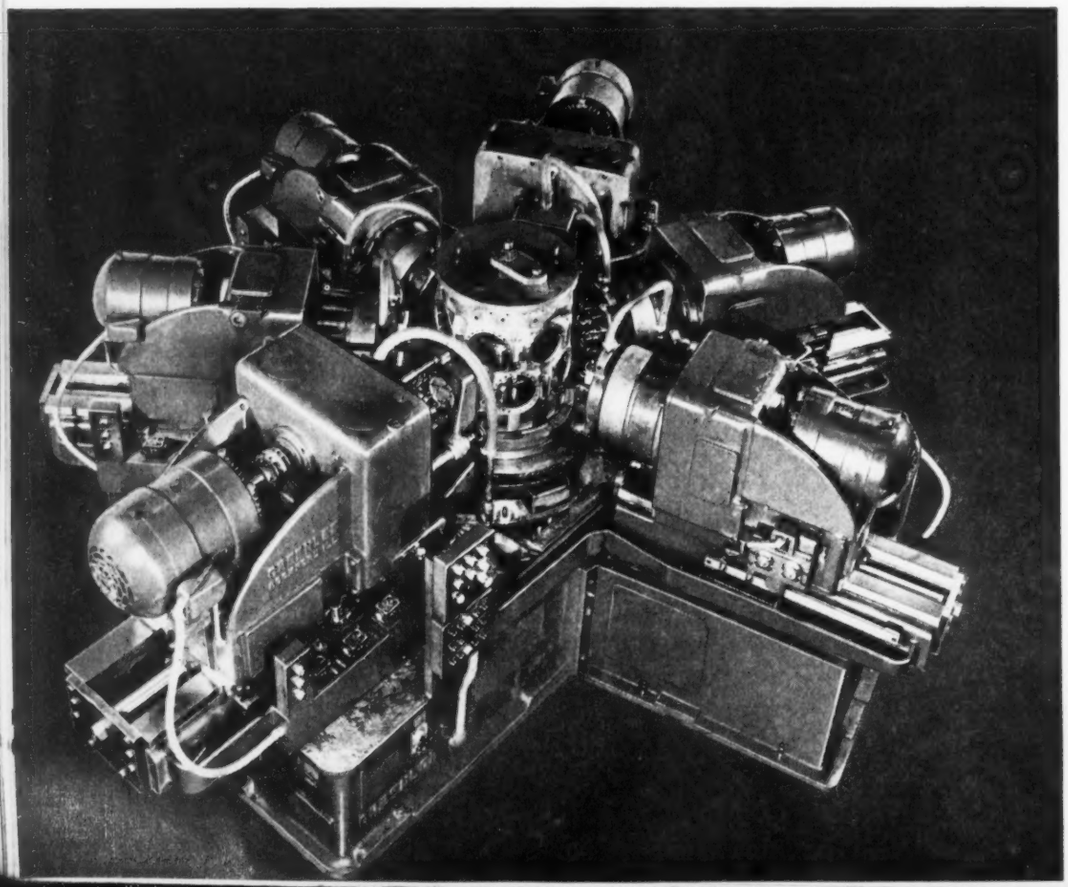


Fig. 4. Special Machine for Drilling and Back-counterboring the Hold-down Screw-holes in Crankcases, which has Taken the Place of Five Semi-production Machines Formerly Required for an Equivalent Output

VICTORY

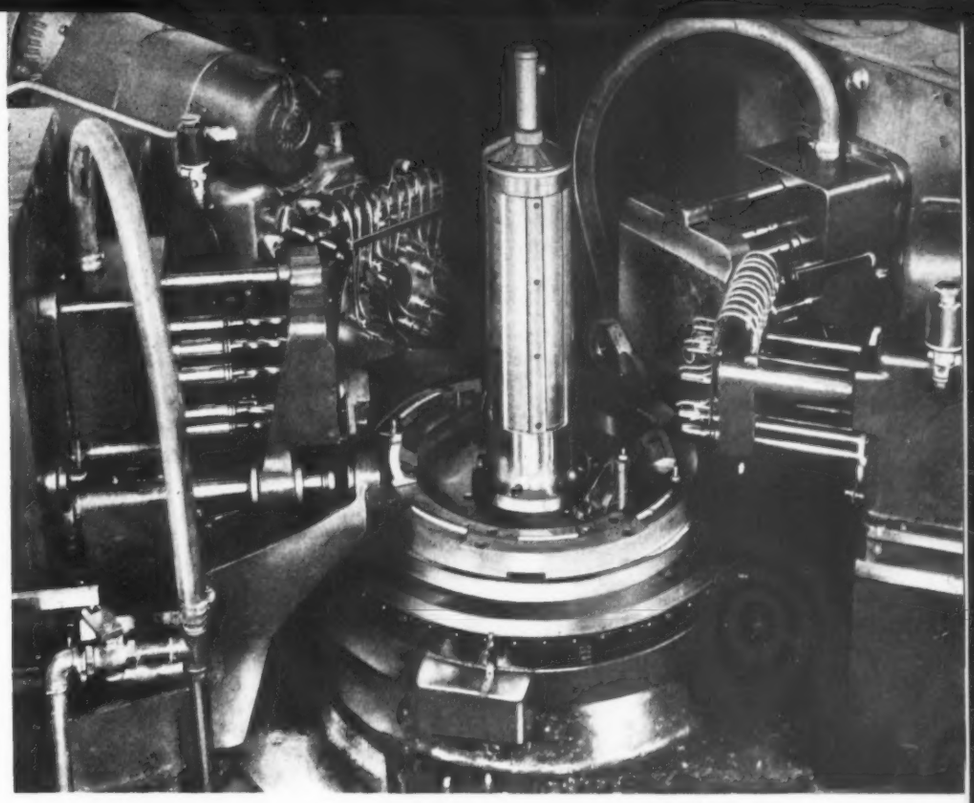


Fig. 5. Close-up View of the Machine Shown in Fig. 6, which Clearly Shows the Individual Pipes Provided for Supplying Coolant Directly to Each Tool

VICTORY

When the twenty trunnions have thus been turned and faced, the machine automatically stops while the part is unloaded. Two of these machines take the place of eleven single-spindle drill presses. The saving in man power amounts to twenty-seven men a day, while the saving in machine costs amounts to almost eight times the cost of the two machines.

An oil-groove is milled one-third of the way around each of these trunnions on special Le Maire milling machines of the type seen in Fig. 15. After the part has been located and clamped on the indexing table, the cutter-head advances rapidly and locks the table by means of an index-pin. When the locking is accomplished, the milling cutter has reached the work, and the head starts to feed. The milling head is slidably mounted on a swiveling sub-base, and is constrained to follow a predetermined path by means of a roller held against a cam by a hydraulic cylinder. When the groove has been milled the proper distance around the trunnion, the hydraulic cylinder moves the head away from the cam and permits the milling head to

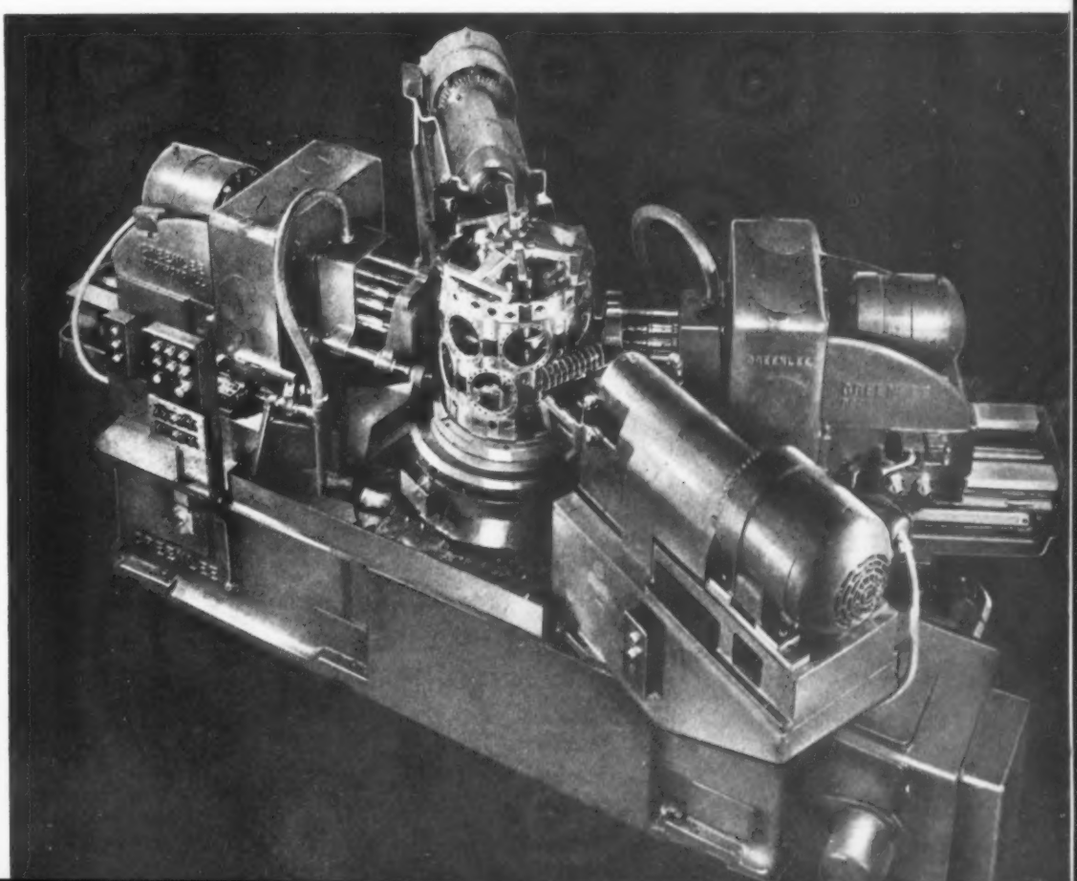


Fig. 6. Machine of Automatic Indexing Type which Takes the Place of Thirteen Machines Previously Required for the Same Production in Reaming, Countersinking, and Tapping Operations on Crankcases

VICTORY

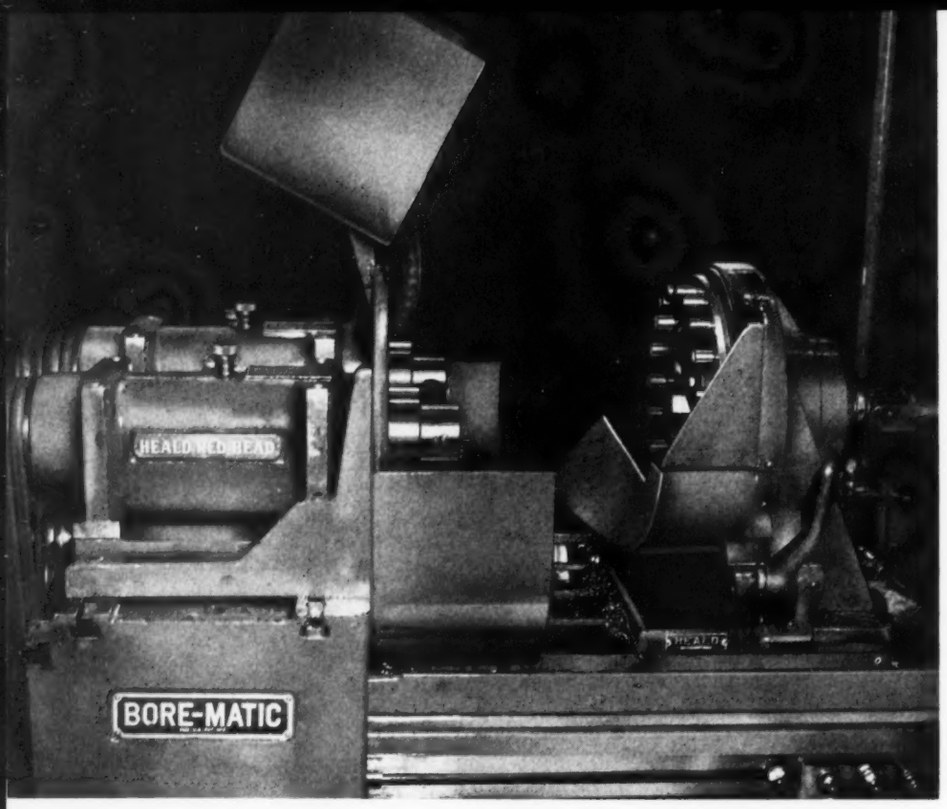


Fig. 7. Bore-Matic, which is Equipped with Two Heads for Turning and Facing Twenty Trunnions on Reduction Gear Carrier Rings

VICTORY

be returned with the cutter backed away from the work. During the return stroke. the index-pin is unlocked and the work-table is indexed 18 degrees to bring the next trunnion into position. This cycle is repeated twenty times, after which the machine comes to a complete stop for unloading the work and reloading.

Adjustments are provided to permit the use of cutters of smaller diameter if desired, and also for varying the vertical position of the cutter. One of these machines takes the place of three standard milling machines, costs a little less than half of what these would cost, and saves the labor of six men a day.

Two oil-holes are drilled and reamed in the same trunnions on special Snyder four-spindle drilling machines of the type seen in Fig. 8. These holes are inclined downward at a 15-degree angle and are 90 degrees apart. In order to perform the operation on a single machine, a very unusual type of construction was adopted. Two 0.067-inch diameter drills are carried on the front head and two 0.078-inch diameter reamers on the rear head. The upper spindle on each head is extended out beyond the lower spindle, so that while the lower one is drilling one hole, the upper is drilling the hole at right angles to this but in the fourth trunnion ahead, the angular displacement being achieved by the fact that the tools approach the part tangentially. Hydraulic feed is employed, and indexing is automatic, positive positioning being

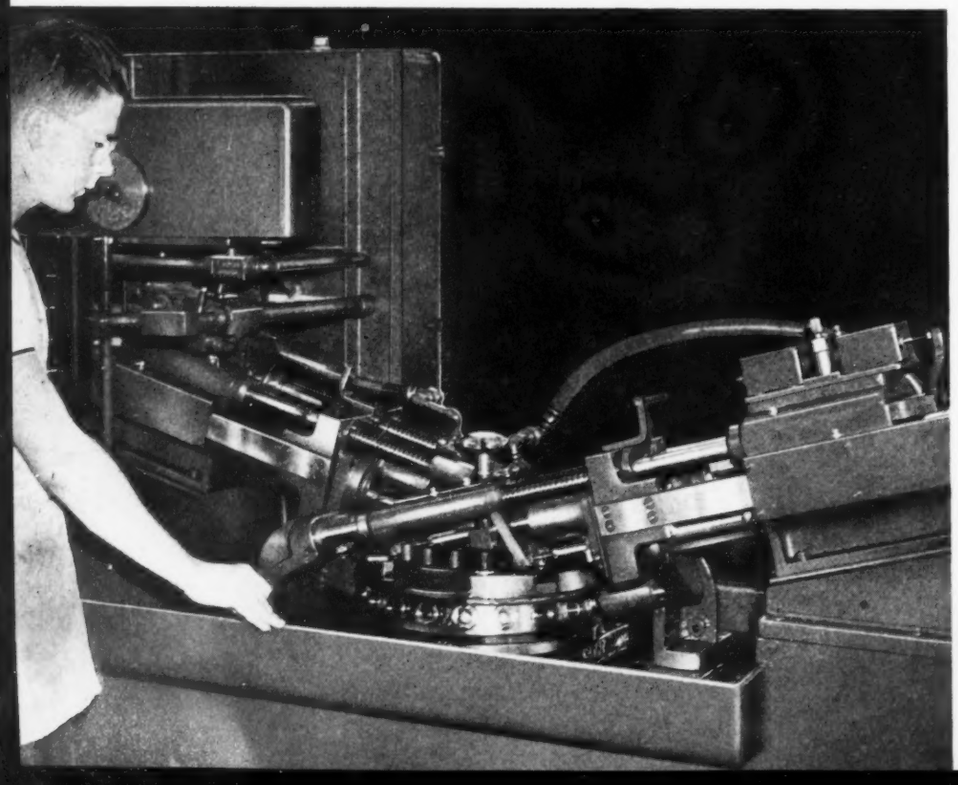


Fig. 8. Machine of Ingenious Design for Drilling Holes 90 Degrees apart in Each of the Twenty Trunnions on Reduction Gear Carrier Rings

VICTORY

SPEEDS PRODUCTION

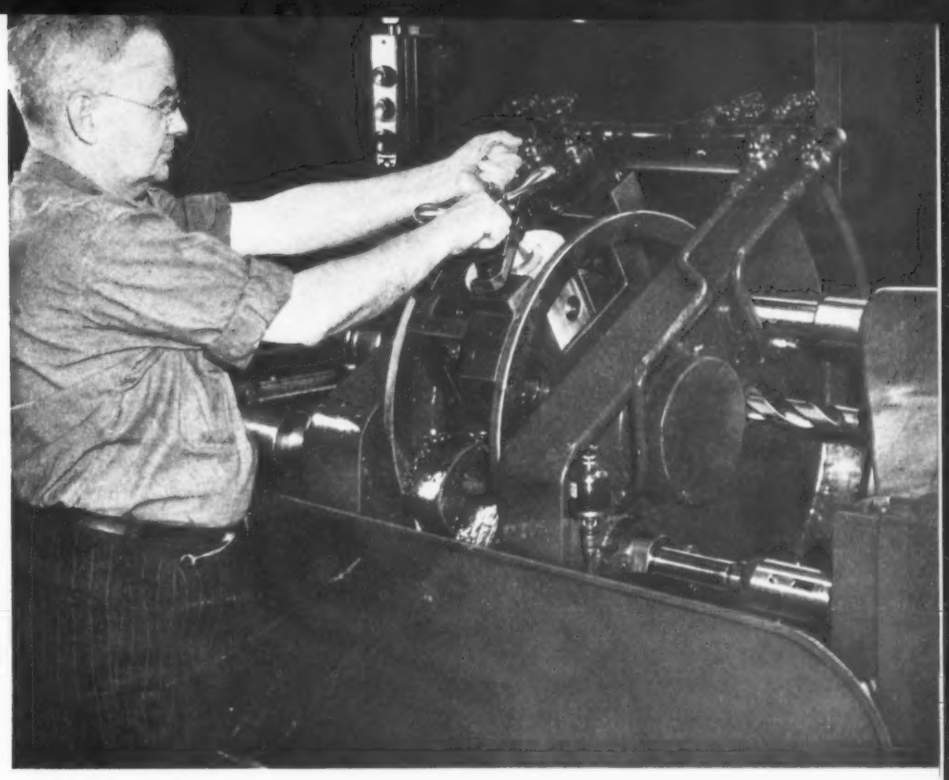


Fig. 9. Drilling and Boring Piston-pin Holes in a Machine that Automatically Carries the Parts to the Drills and Boring Tools

VICTORY

assured by locating pins on the drill heads engaging bushings on the edge of the work-carrier. An automatic cycling device prevents the reamer head from operating until the first two holes drilled have indexed around into the reaming position.

Piston-pin holes are drilled to 1 3 8 inches diameter and bored to 1.440 to 1.442 inches diameter on special Snyder boring machines such as shown in Fig. 9. The parts are loaded into a fixture which indexes automatically in a vertical plane and carries them in succession between the drills and boring-bars, which operate from both sides.

Fig. 10 shows tooling equipment for Greenlee machines designed for rough- and finish-boring, chamfering, and facing the fourteen cylinder deck pads on steel crankcases. They are two-way, horizontal, hydraulic-feed, seven-station, indexing machines consisting of a center base carrying a seven-position automatic indexing turret and having attached to it two wing bases, each carrying an oscillating type hydraulic-feed boring and facing head. These heads are set at different heights above the base to accommodate the upper and lower rows of holes, the center-to-center distance of which is held to within 0.0005 inch.

Parts are loaded over a locating post, which is a loose fit in the main bearing and is equipped with rubbing strips to avoid damaging the surface. Final location is by means of hardened

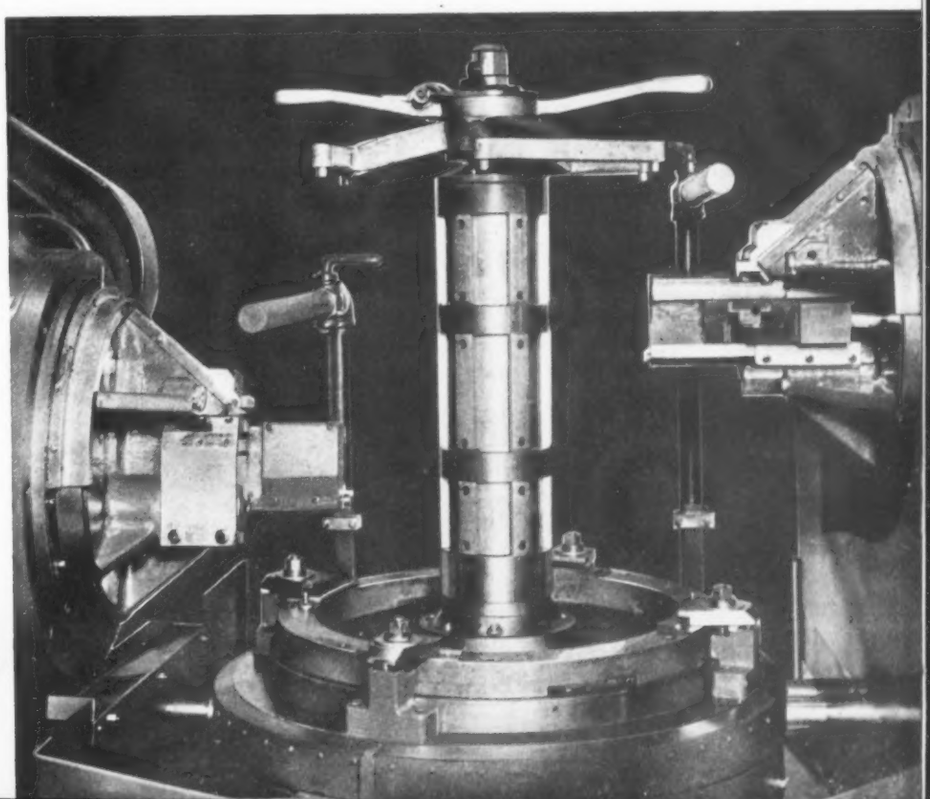


Fig. 10. Cutters Provided on a Horizontal Two-way Machine for Boring, Chamfering and Facing the Fourteen Cylinder Openings in Crankcases

VICTORY

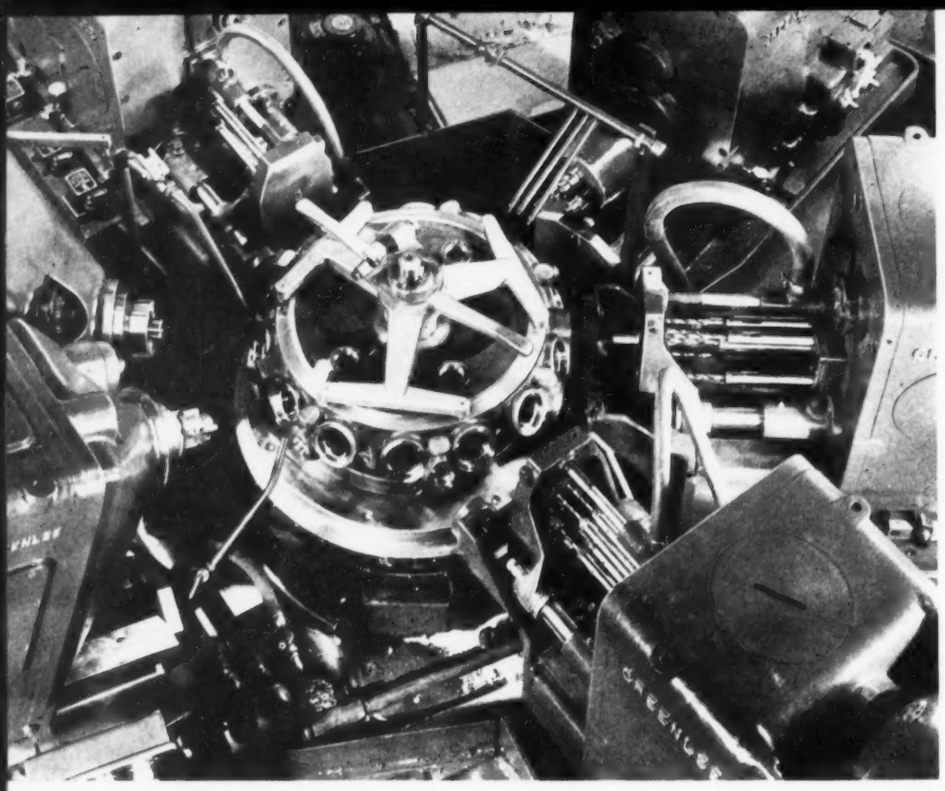


Fig. 11. Close-up View of the Tooling on the Machine Seen in Fig. 12 which Performs Facing, Drilling, and Boring Operations on Supercharger Front Sections

VICTORY

locating blocks which fit into the ground inside diameter of the crankcase. Clamping is effected by four sliding clamps which engage the flange, and also by a large three-arm spider which fits over the center post and bears on the upper edge of the part. This clamp also incorporates a special wrench to prevent distorting the part.

When the machine is started, the two heads advance rapidly to the work and then automatically slow down to the correct rate of feed. The boring-bar first rough-bores a 6.310-inch diameter hole, and then the chamfering tool, which is mounted on an angular slide on the head, advances and forms the chamfer, while, at the same time, the facing tool feeds out radially and rough-faces the pad. On the return stroke, a feed is again employed to produce the finished bore, chamfer, and face. The total time per part is only forty minutes, which represents a substantial improvement over the 580 minutes required per part prior to the installation of this machine.

Hydraulic and electrical controls are interconnected, so that both heads must complete

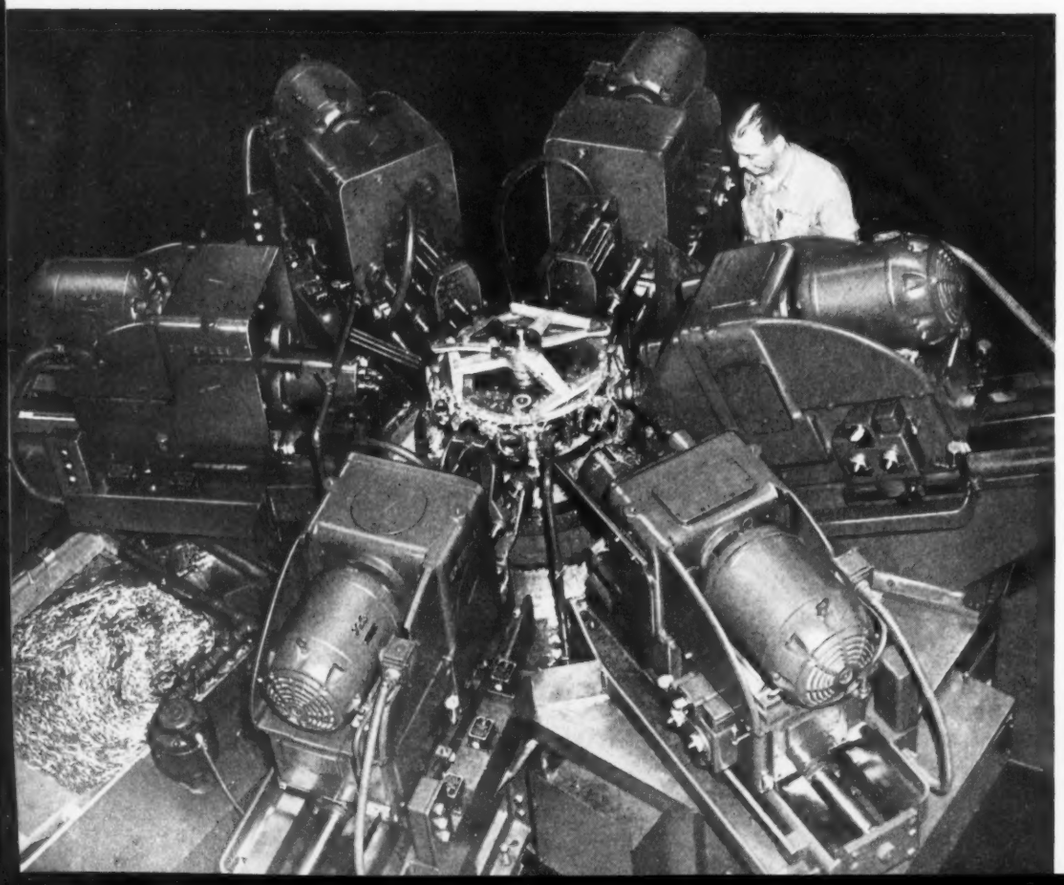


Fig. 12. Six-head Machine which, in Combination with the One Shown in Fig. 14, Performs a Series of Operations in Twenty-four Minutes that Previously Took 224 Minutes

VICTORY

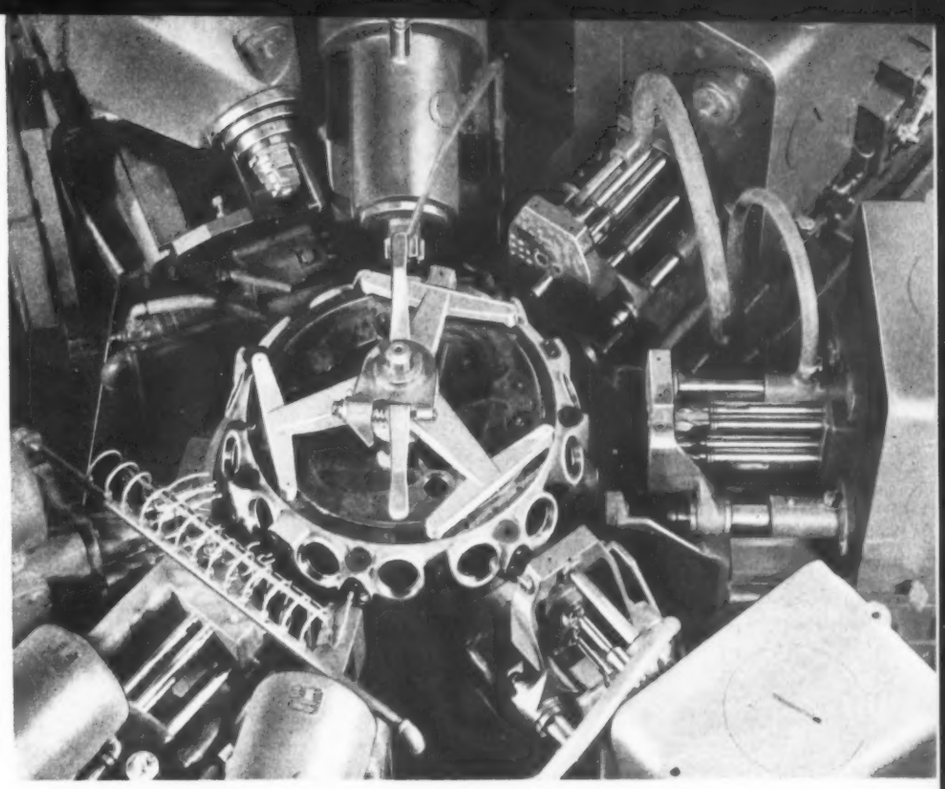


Fig. 13. Close-up View of the Tooling Provided on the Machine in Fig. 14 for Reaming, Countersinking, and Tapping Operations on Supercharger Front Sections

VICTORY

their cycles and be fully withdrawn before indexing can take place. The electric motors are operated on 440 volts, but the control system incorporates a transformer, so that all controls operate on 110 volts, and the danger of arcing and consequent burning of the breaker points is materially reduced.

Two types of Greenlee machines of unusual interest are specially designed for machining the supercharger front or mounting section. The machine shown in Figs. 11 and 12 has six heads arranged around an automatically indexing table, on which the work is located. A three-arm spider clamps the work, and is tightened down by an ingenious wrench which incorporates a spring device and permits applying only sufficient pressure to hold the work, thus avoiding distortion.

During the roughing cycle, the fourteen intake port openings, which are inclined upward, are rough faced and bored, and the seven mounting pads that lie between each pair of ports, in a vertical plane, are similarly rough faced and bored. Three holes in the oil-sump

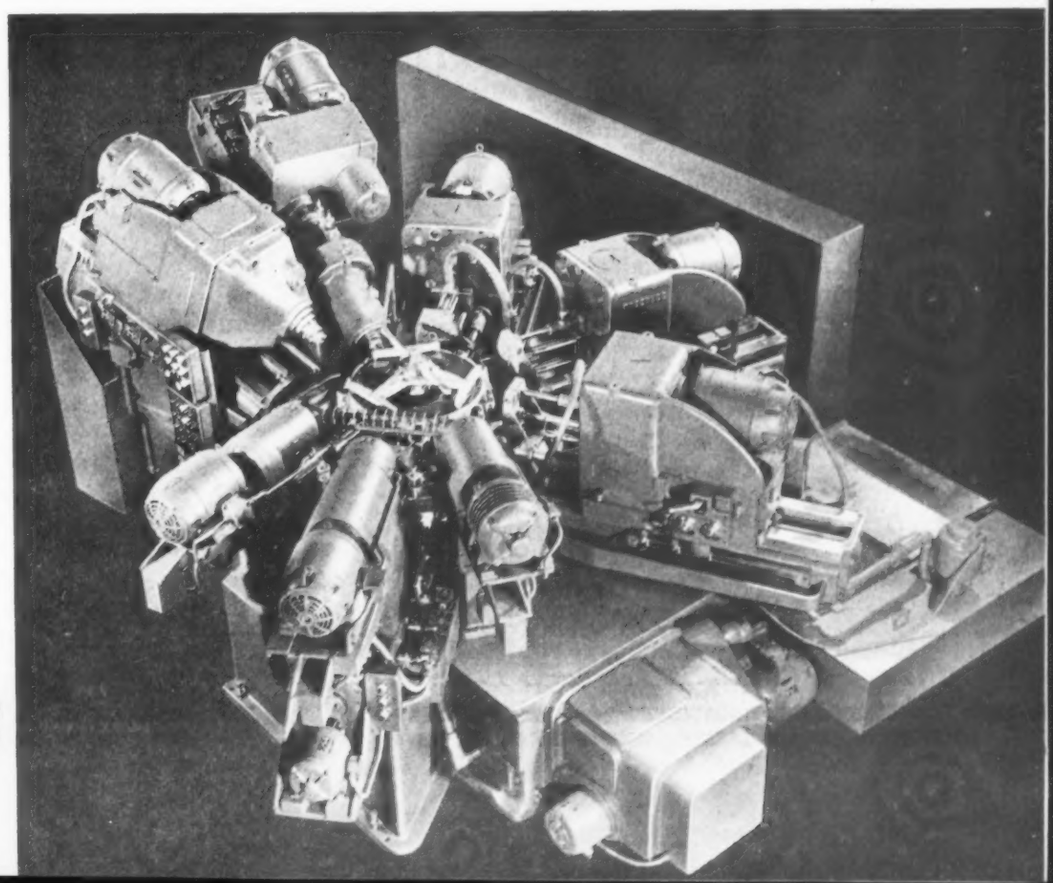


Fig. 14. Multiple-head Machine Used for Reaming, Countersinking, and Tapping Supercharger Front Sections. This Equipment is Used in Combination with Machine Shown in Fig. 12

VICTORY

Fig. 13. Special Machine for Milling a Semi-circular Oil-groove around the Trunnions of the Reduction Gear Carrier Rings

pad are rough-bored. In this cycle, only three heads are in operation, the first head operating fourteen times, the second, seven times, and the fourth, once.

After a sufficient number of parts have been rough-machined, the three roughing tools are removed and replaced by finishing tools. A lever on the control panel is shifted to engage a new set of operating cams, and the machine is then ready for the finish-machining operation. In this cycle, the fourteen intake ports are finish faced and bored, and the seven mounting pads finish-counterbored and reamed. Two holes are then drilled in the face of each mounting pad and four holes in each of two breather pads. The three holes in the oil-sump pad are then finish-bored, and seven additional holes are drilled in the same pad. All six heads are used during this cycle.

All cycles on the Greenlee machines are fully automatic, and the electrical and hydraulic circuits are so arranged that each head must advance, operate, and withdraw fully before the indexing mechanism can operate. Coolant is fed to each individual tool during its operation only, but in addition to this, on the finishing machine, a stream of coolant thoroughly flushes out the reamed intake port holes before tapping. All taps are equipped with individual lead-screws, and the heads and indexing mechanism are hydraulically operated. Of all the many features of these machines, perhaps the most outstanding is the exceptionally massive construction of the spindles. Resembling milling machine spindles rather than those commonly associated with drilling machines, these are in large measure responsible for the remarkable accuracy and high surface finish obtained on these machines.

The machine shown in Figs. 13 and 14 finish-reams and taps the fourteen intake ports; reams, countersinks, and taps the four holes in the two breather pads; reams, countersinks, and taps the two holes in each of the seven mounting pads; and reams, countersinks, and taps seven holes in the oil-sump pad. This machine is equipped with eight operating heads.

The method now in use at the Paterson plant for doing this operation is the same as has always been used, increased production having been obtained by simply increasing the number of machines. In order to obtain a production rate equal to that of two of these new Greenlee machines (that is, like those shown in Figs. 12 and 14), it would be necessary to purchase eight standard machines at a cost of $60,000, and to employ eight men on each shift. Two Greenlee machines of these types cost $84,000 and require the services of only two men on each shift. The difference in cost of $24,000 was saved in two months of running at peak production. The total time required for producing one supercharger front section on this equipment is 24 minutes; under the old method a total of 224 minutes was required.

Not all of the equipment described in the foregoing is in operation in the Cincinnati plant, some of it being in the plants that the Wright Aeronautical Corporation has equipped for subcontractors, but regardless of its geographical location, it is all part of the gigantic effort to speed up production to meet the war demands and to place the aircraft engine for the first time on a mass-production basis.

Important Points on Gages and Gaging Procedure

Defense Production has Emphasized the Importance of Gages in the Successful Application of Interchangeable Manufacturing Methods to Armament Work

By G. H. STIMSON
Greenfield Tap & Die Corporation
Greenfield, Mass.

ONE of the most important items in carrying out defense production is gaging equipment. Gages are as important as machines and cutting tools. The available facilities for gage manufacture in this country two and a half years ago, when hostilities broke out in Europe, were not nearly adequate to meet the demands of war material manufacture. Consequently, many gage manufacturers started to increase their facilities and build up their working forces; and, in addition, the Government arranged for the building of several large gage-making plants to be operated by the leading gage manufacturers of the country.

The Greenfield Tap & Die Corporation is one of the plants that has greatly increased its facilities, including the building and equipping of a new modern air-conditioned manufacturing building exclusively devoted to the production of precision gages.

There are two principal groups of devices used in ascertaining when a manufactured part

Gage Inspection Room of the Greenfield Tap & Die Corporation, Maintained at a Constant Temperature in Order to Permit the Highest Accuracy in Making the Required Measurements

is made to the correct size. One group includes measuring devices; the other, gages.

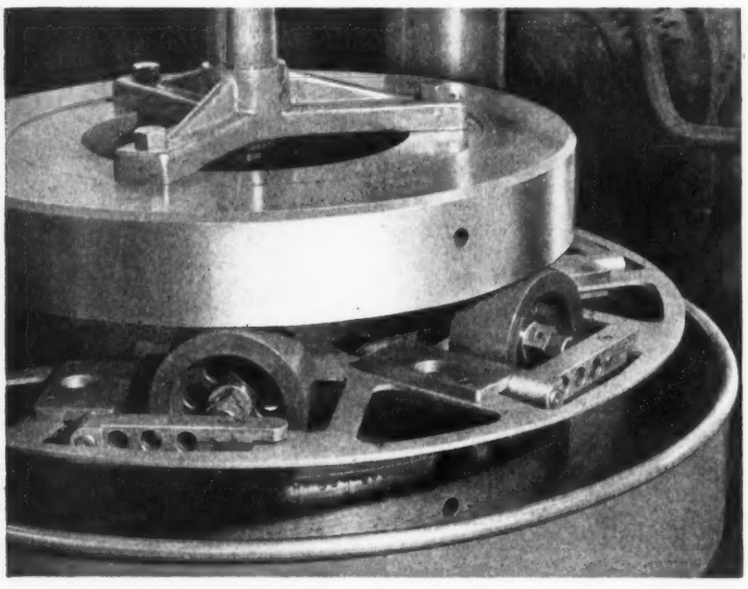
A measuring device is provided with a graduated scale, and the dimension to be measured is compared directly with the scale. This group includes the ordinary machinist's scale, micrometers, vernier calipers, and measuring machines.

Gages are not, strictly speaking, measuring devices. Their function is simply to compare the dimension of the product with a predetermined dimension of the gage. Limit gages establish the maximum and minimum limits of the product within the specified tolerance. The work to be gaged must not be larger than the maximum size nor smaller than the minimum size specified for the product.

Definition of Terms

Before proceeding further, the terms used in connection with gaging in interchangeable manufacturing should be clearly defined. Many of the terms used in gaging procedure are loosely employed, and much confusion is caused by a misunderstanding of these terms. Often serious errors are made in manufacturing simply because the terms are differently interpreted. The four most important terms are tolerance, limit, clearance, and allowance.

Tolerance—Tolerance is the permissible variation in a given dimension. The tolerance may be applied either all above or all below, or split part above and part below the basic dimension. For example, a shaft may be made to any one of the following limits: 1.500 — 1.496; or 1.504 — 1.500; or 1.502 — 1.498. In each case the shaft has different limits, but the tolerance remains the same, namely 0.004 inch.



Mechanical Lapping of Cylindrical Plug Gages

Limit—Limits are the maximum and minimum dimensions of a part. In the previous example, respectively, the maximum limit would be 1.500 inches and the minimum limit 1.496 inches; or maximum, 1.504 inches and minimum 1.500 inches; or maximum, 1.502 and minimum, 1.498. While the limits are all different, the tolerance, as stated before, remains 0.004 inch in each case.

Clearance—Clearance is the space provided between two mating parts when assembled. The purpose of the clearance may be to prevent interference or to produce a certain freedom of fit.

Allowance—Allowance is the intentional difference in size between mating parts. It may be defined as the minimum clearance or the maximum interference that is intended between mating parts. It may provide clearance or interference as desired. When there is clearance, the allowance is called positive; when there is interference, the allowance is called negative.

There are many other terms used that are simply different names for the terms just defined —such as working tolerance, permissible tolerance, necessary tolerance, high limit, low limit, working clearance, and working allowance. The use of these terms causes confusion and should, therefore, be discouraged. Such an expression, for example, as "a limit of 0.001 inch" is objectionable because it is both incorrect and indefinite. It is incorrect because tolerance is meant instead of limit; and it is indefinite because it gives no indication of whether the tolerance is above or below the basic dimension, or partly above and partly below. The expression, for example, may mean a tolerance of 0.001 inch over the basic dimension or a tolerance of 0.001 inch below the basic dimension; it may mean a tolerance of 0.0005 inch both above and below the basic size; or it may mean 0.001 inch both above and below the basic size.

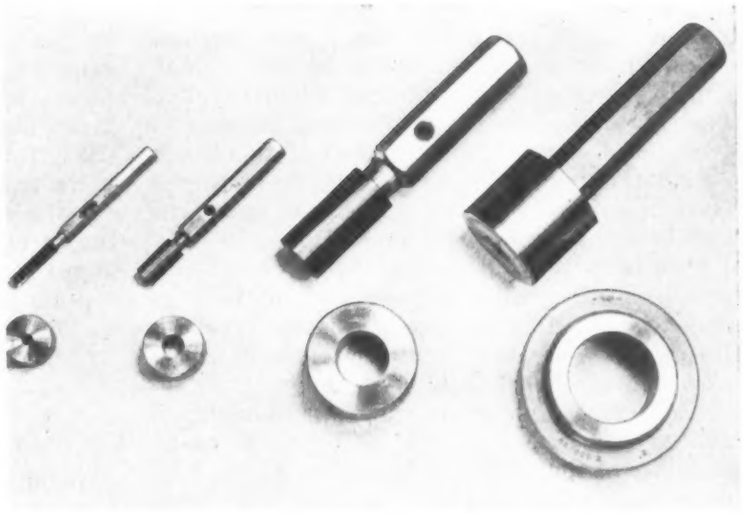
The words tolerance, limit, clearance, and allowance should be used in accordance with accepted practice, so that there can be no possible doubt as to their meaning.

Gaging in Interchangeable Manufacturing

Since gages in general compare only one or, at best, a few predetermined dimensions, they are used principally in interchangeable manufacturing—that is, when a number of similar parts are to be made. Gaging methods and interchangeable manufacturing procedure are so closely allied that it

is impossible to discuss one without the other. The main object in the introduction of interchangeable manufacturing was to decrease costs by standardizing the manufacturing operations and to reduce the time required for assembling a machine or mechanism.

An additional advantage, however, is thereby gained—that of a complete interchange of like parts in manufactured articles. In many cases, the latter advantage has become as important as the reduction in assembling costs. In much war material, this interchange of parts is of prime importance, as, for example, in the manufacture of rifles and heavy ordnance, it permits damaged parts to be replaced quickly without fitting. On the other hand, in shell or projectile work, interchangeable manufacturing methods are used largely for the sake of facilitating assembly, because, when once assembled, there is little likelihood that the parts will be interchanged with other parts.



Examples of Standard Designs of Cylindrical Plug and Ring Gages

One of the most obvious examples of the need for interchangeability arises when one part of a device is made in one shop and other parts are made in another shop. It is clear that "accuracy of dimension" is then necessary, in order that these parts may be properly assembled without additional cost in fitting them together.

When so much of the war materials are subcontracted as is now the case, the necessity of interchangeability and, hence, careful and accurate gaging methods becomes of supreme importance. If two shops work independently, they are likely to use different locating points in taking measurements, different tooling equipment, different machining methods, and different gages and gaging methods. It is of importance that there be thorough coordination between plants working on the same contract in order to insure complete interchangeability. In other words, the gaging equipment and gaging methods must be alike or based upon the same principles. The details of the machining methods and, to some extent, the tooling equipment may vary, but the gages ought to be of identical design; otherwise, it is almost certain that the parts will not interchange properly.

Classification of Gages According to Their Use

In general, three different kinds of gages are employed in an industrial plant, according to their use in the shop and inspection departments —working gages, inspection gages, and reference gages. The latter are sometimes known as checking gages or check gages.

As is evident from the name, working gages are used by the machinist or machine operator at the bench or machine at which he is working, and are used for gaging the product during an operation. Inspection gages, again, are used by the inspectors in checking the product to determine that it meets the requirements. Finally, reference gages are used for testing or checking the inspection and working gages from time to time, to make sure that they have not, through wear, become inaccurate for the purpose for which they are intended. In addition, there are master gages that may be used occasionally as an ultimate check on the reference gages.

Tolerances on the Gages Themselves

It is evident, of course, that the gages themselves can be accurate only within a certain tolerance, as it would be impracticable to make gages that had no measurable error whatsoever. The gage tolerance depends to a considerable extent upon the size of the gage; and in thread gages, upon the pitch.

There are several standardized gagemaker's tolerances applicable to the gages themselves, of different degrees of accuracy. A gage with a certain tolerance should, of course, be selected with relation to the tolerance of the product. It is obvious that there can be no single standard with regard to the tolerance on the working and inspection gages for specified work in interchangeable manufacturing, as these tolerances must depend upon the amount of tolerance allowed in the product being gaged.

For example, if the tolerance on the work or product is 0.010 inch, it is evident that a gage

should not be made to as small a gagemaker's tolerance as would be the case if the tolerance on the work or product were only 0.001 inch. This is the reason why gage manufacturers make some of their standard commercial gages with as many as four different classes of tolerances, so that they may suit the work to be inspected. These four classes fit the majority of cases met with in interchangeable manufacture.

Within certain limitations, it has been found good practice to allow a tolerance on the gage amounting to 10 per cent of the tolerance on the product. For example, if the tolerance on the product were 0.003 inch, then, in general, the tolerance on the maximum gage would be 0.0003 inch, and applied in a direction below the maximum size of the work; the tolerance on the minimum gage would be 0.0003 inch, and applied in a direction above the minimum size of the work.

Use of Working and Inspection Gages

It is the general practice in interchangeable manufacturing to provide working gages for every operation and to furnish each operator with his own working gages.

In designing a gaging system with working, inspection, and reference gages, it is common practice to vary the limits on the gages intended for each purpose. For example, the working gages would not necessarily be made to the limits indicated on the drawing or to the size to which the inspection gages are made. There may be a conflict in the acceptance and rejection of the product when gaged by working and inspection gages made to the same limits. This is due to the manufacturing tolerance on the gages themselves. A product made close to either maximum or minimum limit could be accepted by the working gage and rejected by the inspection gage, due to slight variations in the gage dimensions or wear. To overcome this difficulty, the product tolerance as determined by the working gages may be curtailed sufficiently to allow the product passed by the working gages to be accepted by the inspection gages, regardless of the gagemaker's tolerance.

When the inspection and working gages are alike, disputes often arise as to whether the inspection department is justified in rejecting certain work. Curtailing of the product tolerance by the working gages is a question to be settled by the gage user. It is his responsibility to determine if the extra cost of manufacture entailed by curtailment of the product tolerance by the working gages is compensated for by the freedom from conflict between inspection and working gages.

Inspection gages are usually made so that the largest maximum gage and the smallest minimum gage are equivalent to the maximum and minimum product limits, respectively. As a rule, it is not common practice to inspect the work after every individual operation, but, in general, inspection takes place when the parts leave one department to pass into another, or before they pass from one important operation to another.

Reference and master gages are maintained for the purpose of checking the dimensions of the inspection and working gages. When plug gages are to be used as reference gages, they are generally kept exclusively for that purpose, so that they will not be subject to undue wear.

Tolerances in Interchangeable Manufacturing

In any discussion of gages and gaging procedure, the matter of tolerances on the work is obviously the first consideration. In spite of all that has been written about tolerances and all the research work that has been done, the determination of suitable tolerances is still a puzzle to many designers. If this subject were thoroughly understood, much time and expense could be saved in the manufacture of war materials, in the making of tools and gages for their manufacture, and in avoiding controversies with regard to acceptable material. This, of course, also applies in the manufacture of products for peacetime purposes; but, as a rule, such manufacture is directly in the hands of manufacturing executives who are responsible for profitable results and, therefore, "impractical tolerances" are not so often encountered.

Many designers seem to believe that tolerance should be established with reference to the the minimum tolerance that can be obtained by modern machining methods. Instead, the tolerance should be established with reference to the maximum tolerance permissible in the component parts of a mechanism without interfering with its proper purpose or action. If this principle is kept in mind by designers, the expense of manufacture can be greatly reduced. It is of especial importance at present, in connection with the manufacture of ordnance and other classes of war materials, because, if the tolerances are as liberal as possible, the manufacture of war materials can be greatly speeded up, and costs can be reduced as well.

It should also be remembered that the tolerance on the work will always be less than the tolerance on the drawing, because the dimensions on the drawings are the maximum and the minimum limits of the inspection gages. Hence, it is evident that with gages made to these dimensions, and with reasonable gage tolerances applied inside the product limits, the product that passes inspection must have tolerances that are less than those indicated by the dimensions on the drawing, especially since

most work comes well within the limits of the gages. This means that the tolerance on the drawing should always be made liberal enough to allow for this necessarily smaller tolerance in the work actually produced.

Cylindrical Ring Gages

Dealing now specifically with different types of gages, the first type to which attention will be called is the cylindrical ring gage. These gages are furnished to the trade in four different groups, according to finish and accuracy, designated as Class X, Class Y, Class Z, and Class ZZ. The tolerances corresponding to given size ranges and classes are listed in Table 1.

The life of gages is greatly increased by lapping the contact surface. There is more bearing area on a lapped surface than on a ground surface, since the ridges are greatly reduced by the lapping process.

Class X plain ring gages are precision-lapped to very close tolerances and are used principally as master and reference gages. They are not used as working gages except when especially close tolerances are required.

Class Y plain ring gages, which are also precision-lapped, are used as working gages and inspection gages of accurately ground parts.

Class Z plain ring gages are used when extreme accuracy is not essential and when the working tolerances are fairly liberal. These gages have a ground and lapped finish. This is the regular commercial type of ring gage that manufacturers furnish unless the requirements call for greater accuracy. Class ZZ plain ring gages are ground, but not lapped. They are the most inexpensive ring gages available, and are used when the number of pieces to be gaged is comparatively small and when tolerances are liberal.

Cylindrical Plug Gages

Cylindrical plug gages are made in four classes, similar to ring gages. The tolerances are the same, except that an XX tolerance is added and the ZZ tolerance is eliminated. The four classes of plug gages are designated XX, X, Y, and Z. The tolerances for these gages are given in Table 2.

Table 1. Tolerances for Cylindrical Ring Gages

Size Range		Class X	Class Y	Class Z	Class ZZ
Above	To and Including				
0.029	0.825	0.00004	0.00007	0.00010	0.00020
0.825	1.510	0.00006	0.00009	0.00012	0.00024
1.510	2.510	0.00008	0.00012	0.00016	0.00032
2.510	4.510	0.00010	0.00015	0.00020	0.00040
4.510	6.510	0.00013	0.00019	0.00025	0.00050
6.510	9.010	0.00016	0.00024	0.00032	0.00064
9.010	12.010	0.00020	0.00030	0.00040	0.00080

Table 2. Tolerances for Cylindrical Plug Gages

Size Range		Class XX	Class X	Class Y	Class Z
Above	To and Including				
0.029	0.825	0.00002	0.00004	0.00007	0.00010
0.825	1.510	0.00003	0.00006	0.00009	0.00012
1.510	2.510	0.00004	0.00008	0.00012	0.00016
2.510	4.510	0.00005	0.00010	0.00015	0.00020
4.510	6.510	0.000065	0.00013	0.00019	0.00025
6.510	9.010	0.00008	0.00016	0.00024	0.00032
9.010	12.010	0.00010	0.00020	0.00030	0.00040

Class XX plug gages are precision-lapped to very close tolerances, and are used principally for master gages, master disks, and setting gages.

Class X plug gages are also precision-lapped to close tolerances. They are used for some types of master and inspection gages, and for working gages when the tolerances are especially close and when the highest grade of precision in the work is required.

Class Y plug gages are lapped to slightly larger tolerances than the preceding classes, and are intended to be used as working gages.

Class Z plug gages have what is known as a commercial finish—that is, they are ground and polished, but not lapped. They are used as working gages when the tolerances are liberal and the quantities of pieces to be gaged are small.

Master disks or setting gages designed for checking and setting snap gages, comparators, and micrometers are regularly made with tolerances corresponding to the Class XX, Class X, and Class Y tolerances given in Table 2.

Adjustable-Limit Snap Gages

Among the most generally used working gages are limit snap gages. These gages are designed for quick and accurate inspection of duplicate parts. They are made with two sets of anvils or measuring points, the outer anvils being set to the maximum size and the inner anvils to the minimum size of the work, so that with one quick motion on the part of the operator or inspector the gage will show whether or not the work is made to the prescribed limits.

The contact anvils of adjustable snap gages are made from hardened tool steel, ground and lapped. They are held in place by a locking screw. Each movable anvil can be independently adjusted. Periodical inspection adjustments and corrections must be provided for, since the anvils will become worn through use. Setting plugs or gage-blocks are generally used for adjusting and setting snap gages.

The foregoing principles of gaging practice apply to almost any gaging problem. There are, of course, specialized applications of these principles, but basically, the results are obtained by using the same set of rules. We have dealt principally with external and internal plain members. While these principles apply also to gages for threaded products, the gaging problem becomes more involved—so much so that threaded gages will be handled as a separate subject in an article which will appear in a coming number of MACHINERY.

Planning for Three Shifts, Seven Days a Week

WAY back in the latter part of 1939, the Timken Roller Bearing Co., Canton, Ohio, foresaw the huge demands that would be placed on industry by the Defense Program which has now turned into a War Program. Accordingly, steps were taken by the company at that time to inaugurate a system that would make it possible to keep the plant and its equipment running 168 hours a week—that is, twenty-four hours a day for seven days.

This plan is of considerable interest because it is based on a forty-hour week for each worker, with three eight-hour shifts per day. To maintain this schedule, it is necessary to have four full crews, instead of three, to handle the three shifts. In that way, the working time can be rotated for each crew, so that each works only forty hours a week, except every fourth week, when it works forty-eight hours, which is necessary to make up the full 168 hours each week.

A schedule is laid out covering twenty weeks, after which the schedule is repeated for the next twenty weeks. Except for the week when a man works an extra shift, the schedule is so planned that every man works five days in succession, and is then off for at least forty-eight hours, after which he changes shifts. In each period of twenty weeks, every man has five Sundays off. The shifts are from 12 midnight to 8 A.M., from 8 A.M. to 4 P.M., and from 4 P.M. to 12 midnight. The system provides that the same crews are constantly working together.

The plan worked out by the Timken Roller Bearing Co. will doubtless be of value to many other plants who are contemplating working three shifts, seven days a week, and want to arrange to have four crews working these three shifts. The Timken company has prepared a folder giving a complete lay-out of the shifts for the twenty consecutive weeks. This folder will be sent to manufacturers who are interested in the Timken plan.

Air-Conditioning in the Mechanical Industries

A LARGE number of manufacturing plants in the precision field today have departments that are completely air-conditioned and temperature-controlled. The Taft-Peirce Mfg. Co., Woonsocket, R. I., for example, has made use of air-conditioning equipment for well over ten years. Originally, this equipment was employed in the inspection laboratory, but today the auxiliary floor inspection rooms and all of the gage-lapping departments are air-conditioned.

Recently, a complete floor in the company's new thread gage building was air-conditioned. Here, there will be a single unit in which constant temperature will be provided for both lapping and inspection. The main object is to maintain a temperature of 68 degrees F., the internationally standardized temperature for measurements. A supplementary purpose of the air-conditioning in the gage-lapping rooms is to filter the air and remove all abrasive particles which might cause minute imperfections in the lapped surfaces.

The plant of the Kollsman Instrument Division of the Square D Co., at Elmhurst, N. Y., maker of aircraft instruments, is about 50 per cent air-conditioned. The extremely precise work of assembling and testing aircraft instruments makes it necessary to maintain a constant temperature and to eliminate all dust in the air, as far as possible; hence, all the departments in which very precise work is done are air-conditioned. The equipment also includes the special installation of a dehumidifier. This apparatus keeps the percentage of moisture in the air down as low as possible, so as to reduce the tendency for moisture or perspiration to form on the hands of the workers. Even a slight amount of perspiration has a tendency to corrode some of the delicate parts of the instruments.

* * *

We can't all fight or work in a munitions factory, but we can all help win the war by buying U. S. defense savings stamps or bonds.

Saving Material by Using Tubing

By W. A. CATHER

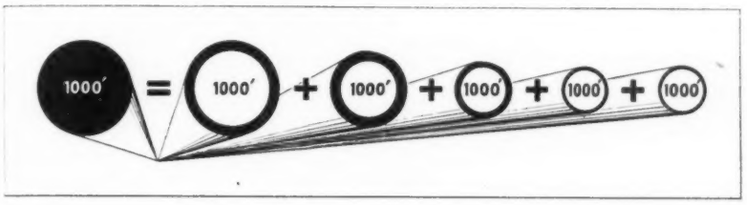


Diagram Showing how the Weight of 1000 Feet of 4-inch Bar Stock is Equivalent to the Combined Weight of 1000 Feet Each of Five Different Sizes of Tubing

MORE than half the steel tonnage now being used for producing certain machine parts could be saved and employed for vital defense work, according to an analysis made recently by the Seamless Steel Tube Institute, Pittsburgh, Pa. In this analysis, the Institute compared the use of solid bars with tubular stock in the quantity production of various cylindrical parts. As an example, consider a part that is 4 inches, or slightly less, in outside diameter with a 3-inch, or slightly larger, hole in the center, and 2 inches long. To make 1000 such pieces from 4-inch bar stock would require 167 feet, or about 7140 pounds of material. If the same parts were machined from tubular stock, the weight of the material would be only 3120 pounds—a saving of over 56 per cent in material.

Looking at it another way, 7140 pounds of bar stock will produce 1000 pieces, while the same number of pounds of material in the form of tubing would make 2292 pieces—more than twice the number of parts.

These savings are obviously the result of using stock that has been, in effect, partly finished by having a hole through the center. It should also be borne in mind that the process used to put the hole in the bar is one that displaces the metal in a forging-like process which improves the steel just as ordinary forging does. Furthermore, any heat-treatment that may be specified for the stock can be accomplished more easily and with greater assurance of uniformity, since a tube is heat-treated both from the outside and the inside, while a bar is heat-treated from the outside only.

It is pointed out that tonnage saving is not the only aspect of this subject. In the absence of Government regulations or priorities, the choice between bar stock and tubular stock will ordinarily be made by the manufacturer on the basis of economy; it is determined by the cost per item of the parts to be made. In this connection, the Seamless Steel Tube Institute has made studies that show substantial savings which may be overlooked if the cost calculations do not include more than comparisons of the cost of bar stock versus tubular stock per finished piece. It is possible that, in addition to the saving in material, the use of tubular stock will result in savings in coolant, less wear and tear on machine tools, longer tool life, and more production per machine.

To further illustrate the savings effected, it is of interest to note that 1000 feet of 4-inch bar stock (weighing a total of 42,720 pounds) weighs no more than 5000 feet of tubing made up in lots as follows: 1000 feet, 4-inch outside by 3-inch inside tubing (18,690 pounds); 1000 feet, 3-inch outside by 2 1/4-inch inside tubing (10,510 pounds); 1000 feet, 2 1/4-inch outside by 1 3/4-inch inside tubing (5340 pounds); 1000 feet, 1 3/4-inch outside by 1 1/4-inch inside tubing (4005 pounds); and 1000 feet, 1 13/16-inch outside by 1 5/16-inch inside tubing (4172 pounds). In other words, the total weight of these sizes—5000 feet of tubing—is 42,717 pounds, as compared with 42,720 pounds for 1000 feet of 4-inch bar stock.

For the sake of simplicity, the amounts and weights of the tubing given in the preceding are calculated on a theoretical basis, without considering the effect of crop ends or the slight extra weight of steel required in producing tubing.

* * *

Women Workers in Aircraft Plants

Sidney Hillman, associate director of the Office of Production Management in Washington, has approached the 200 companies in the country that are directly or indirectly engaged in the manufacture of aircraft, asking them to consider the training and use of women in aircraft work. One of the first companies to respond to this request was the Consolidated Aircraft Corporation, of San Diego, Calif. In this plant, 19,000 men are now engaged in the construction of giant twin-motored and four-motored land and sea bombers for the United States and the British Empire. Women will be immediately trained for the lighter mechanical operations.

EDITORIAL COMMENT

Hiring Men Away from Other Plants Helps Nobody

A practice that caused much trouble to manufacturers in the last World War—that of hiring men away from other plants engaged in war work—is again in evidence. Manufacturers who bid for the services of men employed by someone else engaged in an essential line of manufacture are not only helping to defeat the war equipment manufacturing program, but are also doing something that sooner or later will act as a boomerang to their own business. It is just as easy for manufacturer No. 2 to hire men away from manufacturer No. 1 as it is for No. 1 to hire men away from No. 2; and in the end no one is any better off.

Employment Office Can Help to Build Good Will

The employment manager in an industrial plant can do a great deal to create good will for the company. Some of the larger corporations have made it a rule to have someone see all applicants for employment, whether or not there is work for them at the moment. At one of the large automobile plants, for example, every man applying for work is given an opportunity to enter the employment office and tell what kind of work he is looking for; he is never abruptly turned away at the factory gate, as is the case, unfortunately, in many industrial plants. As a result, the applicant for work at this automobile company, whether he is successful in obtaining employment or not, goes away with a friendly feeling toward the company.

Careful attention to minor details assists the employment department greatly in creating good will for the concern; and good will is particularly valuable to a company manufacturing a product for which almost every applicant may be a prospective buyer.

At the plant referred to, also, many things are done for the applicant's convenience and comfort. There is a large cemented space in front of the employment office, which is kept clear, so that prospective applicants may gather without obstructing the sidewalks. In winter, after a snowfall, this area is cleared early in the morning before any applicants arrive. On rainy mornings, the prospective employes are admitted to a roofed-over passageway.

The applicants enter the employment office one by one. At the information desk, they find a friendly man, with long experience in employment work, qualified to judge the character of each applicant quickly. If a man appears to be suitable for an available job or seems desirable for a job to be filled at some future time, he is directed to one of three waiting spaces set aside for unskilled, semi-skilled, and highly skilled labor. Women applicants are received in a separate room.

While only a large corporation can afford as elaborate an arrangement as that described, there is no question but that it pays, even in a smaller organization, to build up good will by adopting a friendly and considerate attitude toward all seeking employment.

Use Standard Sizes Whenever it is Practicable

Production in all lines of manufacture could be greatly speeded up during the present emergency if designers would avoid, whenever possible, the use of special designs or sizes and specify standard products. One instance recently called to our attention is that of tubing. For almost all purposes where tubing is used, designers could employ the great variety of standard sizes available. Nevertheless, there are many designers who specify special sizes of tubing. This not only causes delay, but increases costs and complicates manufacturing procedure.

What is true of tubing is true of a great many other things—cutting tools, screws, threads, bearing bushings, and all kinds of machine shop accessories. Whenever a standardized product is available, it should be used, if it is at all possible; not to do so is to waste time and money.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

Locking and Releasing Mechanism for Traveling Carriage

By L. KASPER

The stitching mechanism of a machine used for stitching a wire through a fabric must be firmly locked in position during the stitching operation, but must be immediately freed for resetting when the operation is completed. These requirements were effectively met in a simple manner by the mechanism shown in the accompanying illustrations. Figs. 1 and 2 are rudimentary views of the machine with the stitching mechanism omitted to show the driving mechanism, which automatically locks and releases the stitching mechanism in its various positions.

The stitching mechanism is supported on carriage *A*, which rolls freely on two rails *B*, and is operated by gear *H*, which is also mounted on carriage *A*. Gear *H* is rotated by square shaft *G*, supported by bearings *C*. The motive power is furnished by belt *F*, operating on pulley *D*, which is keyed to shaft *G*. Loose pulley *E* is provided for disconnecting the power. Plate *J*, attached to bearing *C* at the right-hand end of the machine, is used for operating the disconnecting mechanism, as will be described later.

In Figs. 1 and 2, belt *F* is shown on the loose pulley *E*. With the belt in this position, no power is applied to shaft *G*, and carriage *A* is free to be moved longitudinally to any position in its range of travel. Square shaft *G* passes through a square hole in gear *H*, to which it transmits motion. The hole in gear *H* is somewhat larger than shaft *G*. During the idle period of the stitching head, shaft *G* is located symmetrically within the square hole in gear *H*, as shown in Fig. 3, the clearance space permitting free longitudinal movement of carriage *A*, Fig. 1.

When belt *F* is shifted to the tight pulley *D*, causing shaft *G* to rotate, the latter carries gear *H* with it, the corners of shaft *G* acting as driving members in the manner shown in Fig. 4. The frictional resistance to rotation of the stitching head produces a sufficiently powerful wedging action of shaft *G* in the square hole in gear *H* to lock carriage *A* firmly against longitudinal movement. This condition exists as long as shaft *G* continues to rotate.

The mechanism that disengages carriage *A* from shaft *G* to permit longitudinal movement is shown in Fig. 5. This illustration shows driving pulley *D* as viewed from the side next to the machine. The internal hub of pulley *D* carries lever *I*, which is clamped to it with sufficient tension to support its own weight, so that the lever and the pulley tend to rotate as a unit. However, the tension is light enough to be easily overcome by the driving power exerted by belt *F* on pulley *D*.

The split bore in lever *I* is lined with leather to prevent scoring the hub of pulley *D*. Plate *J*, the position of which is indicated by dotted lines in this view, is fastened rigidly to bearing *C*, Fig. 2. The outer end of lever *I* carries pin *K* which passes through a slot in plate *J*.

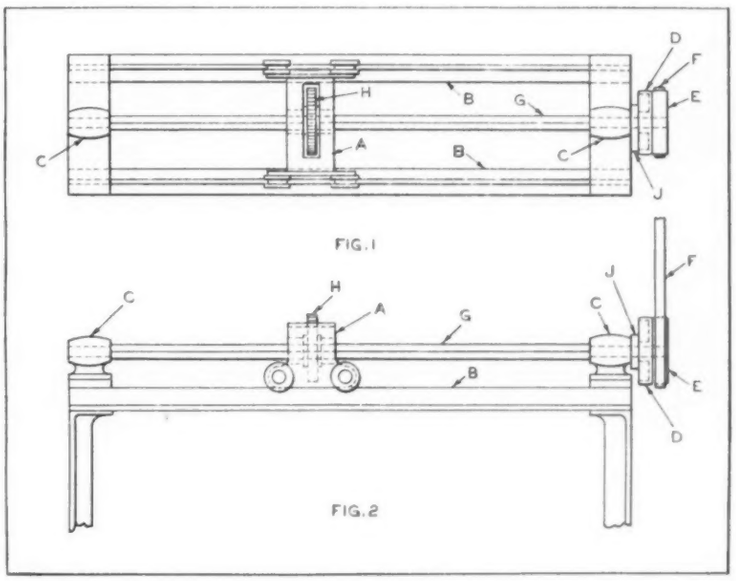
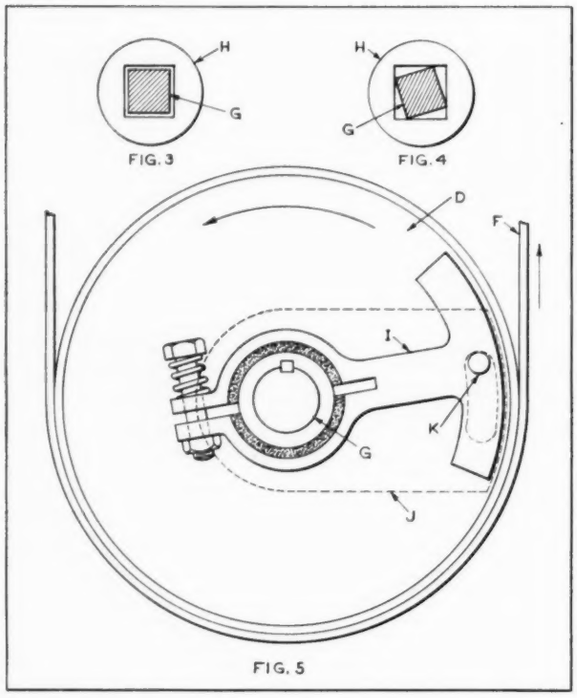


Fig. 1. Plan View of Wire Stitching Machine Frame and Carriage
Fig. 2. Front View of Machine Shown in Fig. 1



Figs. 3 and 4. Diagrams Showing Shaft G in Unlocked and Locked Positions in Gear H. Fig. 5. Mechanism for Unlocking Shaft G

In operation, belt *F* causes pulley *D* to rotate in the direction indicated by the arrow. The friction of lever *I* on the hub of pulley *D* tends to rotate the lever; but as pin *K* comes in contact with the upper end of the slot in plate *J*, further rotation of lever *I* is prevented, as shown in Fig. 5, this position of lever *I* being maintained throughout the stitching operation, or as long as pulley *D* rotates.

When belt *F* is shifted to loose pulley *E*, Fig. 1, the unbalanced weight of lever *I* causes pulley *D* to reverse its direction of rotation until pin *K* comes in contact with the lower end of the slot in plate *J*, at which time shaft *G* has again returned to its unlocked position in gear *H*, as shown in Fig. 3. In this manner, carriage *A* is automatically freed for repositioning at any point of its cycle.

* * *

Generators Forty-Five Years Old Pressed into Service

To supply power for the war emergency, the ten original Westinghouse water-wheel generators installed at Niagara Falls in 1896 were recently placed in regular operation after having been used only for reserve service for the last seventeen years. These generators were in continuous operation from 1896 to 1924. Five of the generators are rated at 4000 kilowatts and five at 3750 kilowatts.

Economies of Improved Planer Drives

In an address made some time ago by John E. Doran, sales manager of the G. A. Gray Co., planer manufacturer, of Cincinnati, Ohio, Mr. Doran called attention to the economic factors involved in the purchase of planers with improved modern drives.

Without having made a careful analysis to determine the most economical equipment to buy, the purchaser might make a snap judgment and say that it is not worth spending the extra money. Why spend 50 to 80 per cent more for a planer drive that will only give 15 to 20 per cent increase in production? It should be remembered, however, that the drive in itself does not produce anything, and the economics of the problem demand that the planer and the motor be considered as a unit. When so considered, the extra cost of a planer with variable-voltage drive, as compared with a planer having constant-voltage equipment, may only be 10 per cent. With a 10 per cent increase in total cost of the combined equipment, there will then be a corresponding increase of from 15 to 20 per cent in production.

Each combination of planer and drive must be considered as a separate problem. In every purchase analysis, the duty of the machine must be taken into consideration. What percentage of the total time is set-up time, tool-setting time, and other elements of idle time? What percentage of the work is short-stroke work, where the greatest savings are made by the variable-voltage drive? What percentage of the time can be saved on short-stroke work and what will be the savings on longer strokes? The other necessary data are obtainable from the electrical manufacturer, and by these means one can determine tangible savings in production by the use of the variable-voltage drive.

It should also be remembered that there are intangible savings, which sometimes even exceed the tangible savings. The planer operator working on a "snappy" machine that "gets up and goes" has a tendency to fall in step with his machine and work faster in all his movements. He sets his tools faster, he sets his job faster, and his machine becomes still more productive, because he decreases the idle time without knowing that he is doing it.

The psychologist may know the reason why this is so. It is probably for the same reason that the pedestrian walking leisurely on the street suddenly picks up in posture, puts more pep into his gait, and actually moves faster, when a band begins to play. There are more factors influencing factory production than improved mechanical equipment alone, important though that be.

Machinability of Ferrous Castings

By E. K. SMITH, Metallurgist
Electro Metallurgical Co., New York City

IT is being increasingly recognized that the degree of machinability of ferrous castings bears a direct and important relation to the cost of the finished product, whether it be a gas stove, a dredge, or an automobile. Another point that is also being realized is that whether the castings are hard or soft, they must be uniform. The output of thousands of men may be influenced by the uniform machinability of certain castings. Once speeds, feeds, and depths of cut are set up, an occasional increase in casting hardness may not only seriously interrupt production, but may cause a permanent lowering of the production rate.

Thus, there is a constantly increasing consumer demand for close control of machinability, and this is being met by the aid of such means as Brinell hardness figures, microstructure analysis, laboratory machinability tests, chemical analyses, etc. In order to make any progress in the improvement, as well as the control, of the machinability of castings, it is essential to have some yardstick by which this property can be measured. Although there is not at present any universally acceptable measure for machinability, several methods are available that are helpful in determining whether or not castings can be machined in a satisfactory manner.

Methods of Measuring Machinability

The Brinell test is the most useful measure of machinability available to the producer of castings. It offers an inexpensive, quick, and reliable yardstick of machinability of any one type of metal. There are, of course, exceptions. For example, Hadfield manganese steel has a low Brinell hardness measurement, and yet it is very difficult to machine, due to work-hardening. Usually, however, the Brinell test is a satisfactory measure of machinability.

The file also gives an excellent indication of machinability in special instances, as for example, on light sections of cast iron. Where a spare drill press is available, a rapid measure of certain types of machinability can be obtained by placing a definite weight on the head of the drilling equipment and then measuring the depth of the hole drilled in a given time. Even with such an inexpensive set-up, the results check closely with those obtained in the production machine shop. An ordinary drill press or a portable drill can be used. This simple test, used in conjunction with Brinell hardness measurements, will give sufficient information for the routine control of machinability, and also for some practical research work if desired.

When the cost is warranted, machines can be obtained by means of which feeds, speeds, depths of cut, and the best tool design can be more or less accurately determined. Much valuable information on the machinability of different types of rolled stock and castings has been obtained by the aid of such machines, but one drawback of this method is that it is not always easy to correlate laboratory tests with production results.

The author has found that malleable castings containing less than 0.20 per cent combined carbon exhibit the greatest machinability. Carbon-steel castings and gray-iron castings, each containing from 0.20 to 1.00 per cent combined carbon, come next, with machinability dropping as combined carbon rises. Mottled cast irons and finally white cast irons follow, with machinability falling rapidly as combined carbon rises over 1.50 per cent. The rapid loss of machinability in mottled and white irons is, of course, due mainly to the presence of hard carbides, but the decrease and final absence of graphitic carbon, which acts as a lubricant in gray iron and malleable castings, is also a factor.

Effect of Constituent Elements on the Machinability of Cast Iron

The excellent machinability of cast iron is due mainly to (1) the lubricating effect of its graphitic carbon; (2) its brittleness, which causes the chips to break off instead of building up a false edge on the tool; and (3) its lack of high strength and ductility, with resulting low power consumption during the cutting operation.

The amount of constituent elements may have an important bearing on the machinability of the cast iron. The effect of various elements is summarized in the following:

Silicon—Silicon promotes machinability, due to its graphitizing effect, up to about 2.75 per cent, which usually gives maximum machinability. When the silicon exceeds 3.00 per cent, there is a decided drop in the machinability and tool life, due to the hardening effect of silicon in solution in ferrite.

Manganese—Manganese in the ranges usually found in cast iron has little effect on machinability. However, if it is either too high or too low, or if it is out of proportion to the sulphur content of the cast iron, the results as regards machining are disastrous. When this element approaches 1.50 per cent, martensite begins to appear, and machining becomes difficult.

Sulphur—Up to approximately 0.14 per cent, sulphur has little adverse effect on machinability, provided there is ample manganese present to form manganese sulphide. Manganese sulphide, being brittle and non-abrasive, promotes machinability.

Phosphorus—The effect of phosphorus on the machinability of cast iron is rather controversial. One investigator has concluded that phosphorus promotes machinability, but the general belief is that steadite,* when present in sufficient quantities, has an abrasive action on the tool. The prevailing opinion is that phosphorus, up to approximately 0.30 per cent, has little effect on machinability, while in the higher ranges it is detrimental.

Graphitic Carbon—Machinability is decidedly promoted by graphitic carbon, mainly on account of its lubricating effect. However, the size and form of the graphite should be such as to give the desired results. Unless the formation of graphite is retarded when heavy sections are cast, the graphite will grow to large size, which, while not interfering with machining, produces an extremely rough machined surface. It may be of interest to note that when a heavy cut has been taken on a casting containing very coarse graphite, the resulting rough finish can be remedied to a great extent by taking a very light finishing cut, which smears over the graphite holes and presents a fairly smooth surface.

Combined Carbon—The machinability of gray iron is inversely proportional to the amount of combined carbon. Modern high-strength castings contain from 0.60 to 0.80 per cent combined carbon, and yet are readily machined at high speeds. It is not until combined carbon is high enough to cause the formation of massive cementite that there is any detrimental effect on machinability.

Nickel—Nickel has a decidedly beneficial effect on machinability in the amounts (say up to 2 per cent) ordinarily found in cast iron. It is particularly effective in promoting graphitization in light sections which otherwise would be unmachinable.

Chromium—Chromium hardens cast iron, but little effect on machinability is noted until carbides appear in the microstructure. The amount of chromium required to produce carbides depends on the base metal. If the base metal contains high percentages of silicon and carbon, chromium may be present up to 1 per cent without an adverse effect on machinability.

Molybdenum—Molybdenum hardens the matrix of cast iron, but has little effect on machinability in the quantities ordinarily used. When over 0.50 per cent of molybdenum is present, the hardening effect becomes apparent, and machinability is decreased.

Copper—Copper acts in a manner similar to nickel, promoting graphitization and thus increasing machinability. Its action in this respect is probably not so strong as that of nickel.

Zirconium—Zirconium is an active deoxidizer, and when added in the amount of about 0.15 per cent, increases machinability.

Titanium—The action of this alloy is quite similar to that of zirconium, as it acts as a deoxidizer, and in small amounts promotes machinability.

Vanadium—Vanadium is a strong carbide former, and its action is similar to that of chromium. In the small amounts ordinarily used, it has little or no effect on machinability, but when present in sufficient amounts to produce massive carbides, machinability is decreased.

Other Factors Affecting Machinability

Another important factor affecting the machinability of cast iron is its structure. Ordinary cast iron shows, in its microstructure, graphitic carbon, which promotes machinability; ferrite, which is very machinable; and pearlite, which is moderately machinable. Carbides reduce machinability by abrasion of the tool, and are usually held to small proportions, except where resistance to wear is desired.

Annealing cast iron at from 1400 to 1500 degrees F. (760 to 816 degrees C.) causes the breaking up of carbides and of pearlite into graphitic carbon and ferrite, thus promoting machinability, but decreasing strength and resistance to wear. When it is desired to make castings with extreme machinability, where strength and resistance to wear are not of great importance, an annealing operation is indicated. The Brinell hardness number of a completely annealed cast iron is approximately 130.

One very machinable type of cast iron is that cast in permanent molds, so that there is no adhering molding sand, then annealed rapidly, and cooled slowly. The resulting structure is ferrite and graphite.

Generally speaking, machinability is inversely proportional to strength. However, modern high-strength cast irons with tensile strengths up to 65,000 pounds per square inch are being machined readily at high speeds.

Brinell hardness is proportional to the percentage of combined carbon and, therefore, in-

*A binary eutectic consisting of 10 per cent phosphorus and 90 per cent iron.

versely proportional to machinability. Supermachinable soft gray irons run from 120 to 140 Brinell; ordinary automotive "soft irons" run from 160 to 185; automotive "hard irons" run from 185 to 228; and the high-strength alloy irons may run as high as 300 Brinell.

The thinner the section, the greater is the tendency toward separation of carbides, with resulting decreased machinability. However, if the mixture contains sufficient silicon or nickel or copper, there need be no difficulty in machining light sections. When extremely light sections have to be machined at high speeds, the metal should have sufficient stiffness to withstand machining strains without distortion.

Factors Impairing the Machinability of Cast Iron

Occasionally, castings have a very thin surface layer of white iron. This may be due to wet molding sand or too quick cooling or defective composition, and can be handled accordingly.

A frequent cause of complaint from the machine shop is a thin layer of fused-on molding sand, which may be caused by excessively high pouring temperatures or too low a fusing point in the sand. This occurs so often that it is general practice to take a heavy first cut, so that the tool will cut under the molding sand on the surface.

A rather unusual difficulty with machinability may arise when austenitic castings, usually containing large proportions of nickel or copper, are tumbled in order to clean them of molding sand. The tumbling operation may cause the surface to work-harden to such an extent as to become unmachinable.

Any type of inclusion within the casting has some effect on machinability. Hard inclusions usually affect machinability adversely, as they rub against the cutting tool and wear it through direct abrasion. However, the amount of this effect depends also on the structure of the iron.

An illustration of this will be familiar to residents in the North. When a ferry boat pushes through loose cakes of ice in the river, the small cakes are readily shoved to each side with no noticeable effect on the boat. But if the boat happens to be on the first trip in the morning and the river is covered with a thin layer of solid ice, when the boat hits the dispersed cakes of free ice, they are held more or less rigidly by the solid ice behind them, and the result is a continual grinding and abrasive action on the hull. In a similar way, if a stiff, hard type of gray iron contains considerable quantities of extremely hard particles, whether alumina, steadite, or hard carbides, these rub against the tool, causing excessive wear. If, however, these particles are loosely held in a softer type of cast iron, such abrasive action is minimized.

The machinability of steel and malleable iron castings will be dealt with in an article to be published in a coming number of MACHINERY.

Fiftieth Anniversary of Hyatt Bearing Organization

THE year 1942 marks the fiftieth anniversary of the Hyatt Bearings Division of the General Motors Corporation, Harrison, N. J. It was in 1892 that John Wesley Hyatt, one of America's foremost inventors, established the Hyatt Roller Bearing Co. Mr. Hyatt, in a sense, was the originator of the plastics industry through his previous discovery of celluloid. His invention of the roller bearing and later developments by other anti-friction bearing manufacturers ushered in a new era in industrial and transportation power and motion transmitting equipment.

Alfred P. Sloan, Jr., later prominently identified with the growth and development of the General Motors Corporation. when first out of college became a draftsman with the Hyatt organization. Successively he held various important positions with the company until he became its president and guided the firm through its major period of development. This coincided with the growth of the automobile industry, which has depended, to a large extent, upon anti-friction bearings. Under Mr. Sloan's leadership, the Hyatt company was brought into the General Motors group, of which he now serves as chairman of the board. Today, the Hyatt Bearings Division supplies bearings to almost every industrial and armament field. Among the chief industries served, besides the automobile industry, are the mining, railroad, agricultural, textile, and aviation fields.

* * *

For the building of a 0.30-caliber Browning machine gun at the Saginaw Steering Gear Division of the General Motors Corporation, more than 8000 drawings were prepared, including drawings for the tools and special equipment. The gun itself contains 189 separate parts, the machining of which, from rough forgings, involves about 1800 separate operations. There are 66 operations on the bolt alone.

Engineering News Flashes

Airplane Engines Develop Power for Their Own Manufacture

In the new engine plant of the Ford Motor Co., the power developed in testing the engines is used for production purposes. Engines for military aircraft are given a preliminary test run of several hours. They are then torn down, inspected, and reassembled for a final run. Both the first and the final runs are made under load. At the present time, millions of gallons of gasoline are consumed monthly in making these tests. In the past, the engines wasted the power produced by driving special propellers. Not only was this practice wasteful, but it also created much objectionable noise.

To save this power, the Ford Motor Co. has installed sixteen Westinghouse 1250-K.V.A., 720-R.P.M., synchronous generators; each generator is connected to an engine through a hydraulic slip coupling, so arranged that when the engine speed exceeds 720 R.P.M., the generator runs at a constant speed and delivers power to the plant alternating-current bus. Sufficient power is recovered in this manner to supply a large percentage of that needed for the manufacture of the engines.

Electromagnetic Gage Measures Strain on Machine Parts

A new type of electromagnetic gage has been developed by H. P. Kuehni of the engineering laboratory of the General Electric Co., Schenectady, N. Y., to measure the strain on machine parts subjected to sudden loads. In some kinds of machines, such as power presses, shears, and press brakes, the extreme strain during a cycle of operation occurs for a very brief period of time—rising abruptly to the maximum and then falling sharply to zero. It is for this type of machine that the gage has been developed as a protective device to forestall breakage.

The gage can be connected so as to give more than one kind of indication. A direct value of the maximum strain can be obtained from an instrument in front of the operator; and a light or bell can be attached so as to give a signal when a predetermined strain has been reached. The gage—comprising a rod, lever arm, and head—looks like a side view of an automobile jack when attached to the machine. The ends of the rod are fastened to the machine in the direction of the strain. The lever arm, attached at its outer end to the machine, is at right angles to the rod. The gage head is mounted on a plate which is attached to the machine at a point in line with the lever arm. The gage head consists of an armature operating within two coils.

Before work is started, the position of the armature within the coils is adjusted so that a zero reading is registered on a connected instrument. When the machine is put into operation and there is a strain, the rod pulls down on the lever arm. The arm, in turn, pulls down on a pin in the armature and moves the armature to a new position within the coils. This affects the electromagnetic relationship between the armature and coils in accordance with the amount of strain exerted. The instrument, previously calibrated against known strain loads, then indicates the extent of the strain.

Induction Hardening Saves 700,000 Pounds of Copper for Defense Use

Before induction hardening was adopted by a large Michigan automobile plant, it was necessary to use copper bushings in a rocker arm to prevent wear of the shaft. By high-frequency heating and quenching, the hardness of the shaft was increased from 20 to 50 Rockwell C. This hardness was sufficient to prevent shaft wear when the rocker arm was used without the copper bushing. Since about 14,000,000 bushings weighing 0.8 ounce each were used annually, a saving of 350 tons of copper resulted. Nearly 5,000,000 shafts have been processed during the last two years without a single rejection that could be traced to improper heating.

The shafts are hardened six at a time in an upright hardening furnace in which the heating and quenching cycle is 4.5 seconds. There is no oxidation of the surface and no grain growth in the unhardened metal sections. Although there is some distortion of the hardened shaft, there is no need for any other corrective operations than the finish-grinding and final lapping.

Shell Production Increased by the Use of "Dry" Lubricant

The experience of at least one forging plant indicates that graphoid-surfacing of mandrels and piercers for the hot-forging of shells is

MACHINERY'S DATA SHEETS 459 and 460

TYPICAL APPLICATIONS OF SAE STEELS—9

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Pawls

Low-carbon steels Nos. 1010 and 1015.

Low-carbon steel No. X1015 has improved machinability and hardening properties, due to manganese content.

Pins

Low-carbon steel No. 1020, a standard carburizing grade, is used for wrist-pins.

Low-carbon steel No. X1020, a high-manganese variant of steel No. 1020, is used for its improved machinability and hardening properties. This steel carburizes and hardens freer from soft spots than steel No. 1020.

High-carbon steel No. 1085 is used for lock-pins.

High-carbon steel No. 1090.

Nickel-chromium steels Nos. 3115 and 3120, suitable for carburized and heat-treated parts, are used for piston-pins.

Molybdenum steel No. 4320 for chain pins has excellent core strength and surface hardness.

Molybdenum steels Nos. 4815 and 4820 have excellent core and surface hardness, together with good wear resistance. They are used for steering knuckle pins and chain pins.

Plows and Plow Parts

See Agricultural Machinery Parts.

Races, Bearing

Chromium steel No. 52100 is frequently drawn into tubing for bearing races.

Ring Gears

See Gears.

Rings, Snap

Medium-carbon steel No. 1060 is used, and for this application a hardness of 45 to 50 Rockwell C is recommended.

Rivets

Low-carbon steels Nos. 1010 and 1015 are used for cold-heading wire.

Medium-carbon steel No. 1035 is used for wire and rod for cold upsetting.

Rods, Connecting-

Medium-carbon steel No. 1040 has fair machining properties and deep-hardening characteristics.

Nickel-chromium steel No. X3140, a higher chromium and manganese variant of steel No. 3140, is used where improved hardening characteristics are desired.

Chromium-vanadium steel No. 6135.

Roller Bearings

See Bearings.

Screws, Machine, Special Types

Nickel steel No. 2330 is primarily used where considerable strength and toughness are required.

Nickel-chromium steels Nos. 3135 and 3140 are used where good physical properties are required.

Chromium-vanadium steel No. 6135.

Chromium-nickel austenitic steel No. 30615 is a free machining type.

Stainless chromium iron No. X51410 is a free machining grade used for corrosion-resistant parts.

TYPICAL APPLICATIONS OF SAE STEELS—10

This listing, based on the 1941 SAE classification of steels, is not intended to be complete, but rather to indicate by typical examples what steels are suitable for various types of applications.

Shafts and Shafting

Low-carbon steel No. 1020, a standard carburizing grade, is suitable for camshafts.

Low-carbon steel No. X1020, a higher manganese variant of steel No. 1020, has improved machining and hardening properties and carburizes and hardens freer from soft spots.

Medium-carbon steel No. 1040, with fair machining properties and deep hardening characteristics, is suitable for crankshafts.

Medium-carbon steel No. 1045, intended for the larger sizes of plain carbon-steel forgings, is suitable for axle shafts and spline shafts.

Medium-carbon steel No. 1050 is intended for parts of larger section than No. 1040.

Nickel steels Nos. 2340 and 2345 are used for propeller shafts, spline shafts, and axle shafts to give great strength and toughness.

Nickel-chromium steels Nos. 3115 and 3120, intended primarily for carburized parts, are suitable for spline shafts and countershafts.

Nickel-chromium steels Nos. 3135 and 3140, used for many heat-treated structural parts where good physical properties are required, is suitable for crankshafts, axle shafts, and spline shafts.

Nickel-chromium steel No. X3140, used where improved hardening characteristics are desired for parts of large section, is suitable for axle shafts and crankshafts.

Nickel-chromium steels Nos. 3245 and 3250, intended for oil-hardened parts, machined or forged, requiring very high physical properties, are suitable for heavy-duty axle shafts.

Molybdenum steel No. 4140 is used for rear axles, front axles, propeller shafts, and transmission shafts.

Chromium-nickel-molybdenum steel No. X4340 is suitable for oil-hardening axle shafts and heavy-duty shafting over 2 inches in diameter, where high strength and anti-fatigue properties are required.

Molybdenum steels Nos. 4615 and 4620 are used for shafts where high fatigue resistance and tensile strength are needed. Excellent where minimum distortion is essential.

Molybdenum steel No. 4640 is used extensively where high fatigue resistance and physical properties are required. The fine-grained types are excellent steels where minimum distortion is a prerequisite.

Carburizing nickel-molybdenum steel No. 4815, in which high core strength can be developed with a single quench, is suitable for heavy-duty spline and transmission shafts.

Chromium alloy steel No. 5140 may be used interchangeably with steels Nos. 2340 and 3140 for heat-treated forgings requiring greater strength and toughness than are obtainable with the plain carbon steels.

Chromium alloy steel No. 5150, an oil-hardening steel, is suitable for shafts.

Chromium-vanadium steel No. 6135, a medium-carbon grade, is suitable for axle shafts and propeller shafts.

Chromium-vanadium steel No. 6150 is suitable for heat-treated forgings subject to severe conditions, where high strength and anti-fatigue properties are essential.

Stainless chromium iron No. 51335, capable of heat-treating to a relatively high hardness, is used for hardened pump shafts.

effective in greatly increasing the life of these tools, preventing sticking, and insuring greater uniformity in the forged shells.

For the initial coating, an aqueous suspension of Aquadag (colloidal Acheson graphite) is used. As the work progresses, the lubrication is maintained by subsequent dippings in suspensions of colloidal graphite. Piercers, for instance, are first heated to 300 degrees F. and dipped from seven to ten times while at this heat into a 5 per cent solution of Aquadag. This provides the forging tool with a coating of very fine graphite particles.

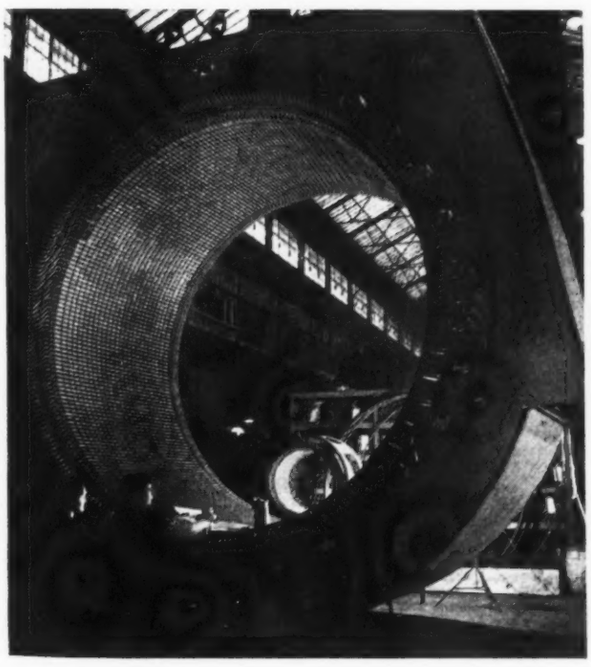
While under the effect of friction and heat in operation, this coating becomes practically embedded in the surface of the forging tool, forming a graphoid surface. The coating is maintained in service through lubrication with a mixture of 3 per cent concentrated Oildag and 7 per cent deflocculated graphite suspended in a paraffin base oil of about 350 seconds viscosity at 100 degrees F., with a flash point of from 375 to 400 degrees F.

It is stated that, with mandrels and piercers lubricated in this manner, an output of 14,000 shells per tool was obtained in one case, as compared with from 6000 to 8000 shells formerly produced. It is stated that by nitriding the surface of the vanadium alloy piercers and mandrels in combination with the Aquadag dip and the Oildag lubrication, the output per tool has been practically doubled again.

In the dipping process, the hot mandrel is immersed until the liquid stops "hissing." It is then removed, allowing the residual heat to dry off the moisture. Occasional resurfacing of the mandrels and piercers by redipping in Aquadag has also been found to be effective in maintaining the graphoid coating.

The Air-Conditioning of Manufacturing Plants

More and more manufacturing plants are being air-conditioned. The York Ice Machinery Corporation has obtained a contract for the mechanical refrigeration system to be used in air-conditioning the mammoth windowless Douglas bomber assembly plant now being built at Tulsa, Okla. With a cooling capacity equal to the melting of 7000 tons of ice daily, this system will be one of the two world's largest single installations of refrigerating equipment for air-conditioning. The cooling effect will be equivalent to that of a column of ice 6 1/2 feet square and 1 mile high, melting away completely every twenty-four hours.



Building a 40,000-H.P. Giant Fan Motor at the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co. This Motor will Drive Air at a Maximum Velocity of 400 Miles an Hour through a New Plane Testing Wind Tunnel at the Wright Field, where Army Engineers will Test Full-sized Plane Propellers and Engines, as well as Create

Actual Flying Conditions for Models of New Military Aircraft. The Illustration to the Right is a Close-up View, which Gives a Clear Conception of the Enormous Size of the Stationary Member of the Motor. At Maximum Speed, the Motor Requires 85,000 Cubic Feet of Air to be Forced through it Every Minute to Keep it Cool

Converting Single-Spindle Automatics to Speed up Bearing Production

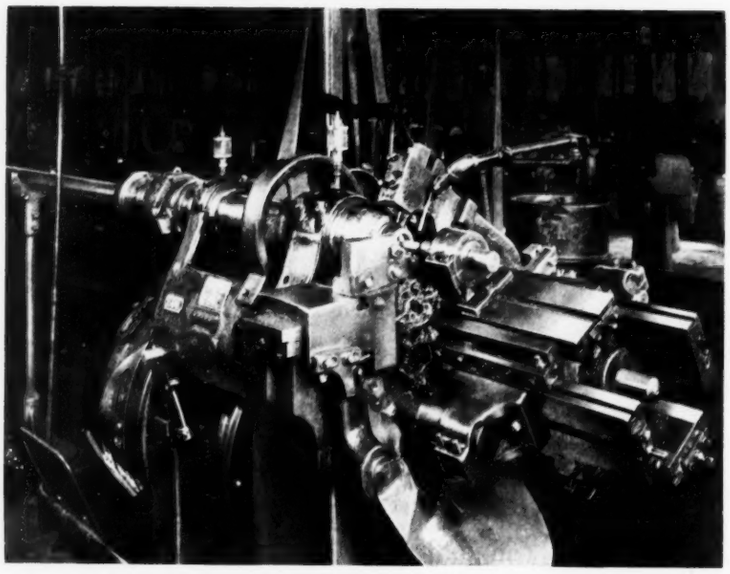


Fig. 1. Single-spindle Automatic before its Conversion for Use in Machining Large Taper Roller Bearing Races

CONFRONTED recently with the problem of speeding up the production of large size bearings for tanks and trucks, the Timken Roller Bearing Co., Canton, Ohio, solved the problem in a manner that is worth consideration by everyone encountering production problems in the armament program. The available machines capable of handling bearings of the sizes required were working at full capacity, and at the same time, drastic curtailment of passenger car production had thrown forty automatic machines of smaller size out of production. The smaller machines had a maximum outside diameter machining capacity of 3 1/4 inches, whereas the bearings to be produced required machining operations on work from 3 1/4 to 10 inches in diameter.

Under normal conditions, obviously, new machine tools would have been purchased. However, since new machines could not be obtained, the only solution was to retool the smaller machines to accommodate work up to 8 inches in diameter. Timken engineers discovered that all the single-spindle machines could be made to handle the forming operations, but were incapable of performing the cutting-off operations on the larger tubes or stock. A number of the heavy-duty, single-spindle automatics that had been producing completed parts were, therefore, set aside to perform the cutting-off operations required to produce the blank bearing races which could be readily machined on the smaller automatics.

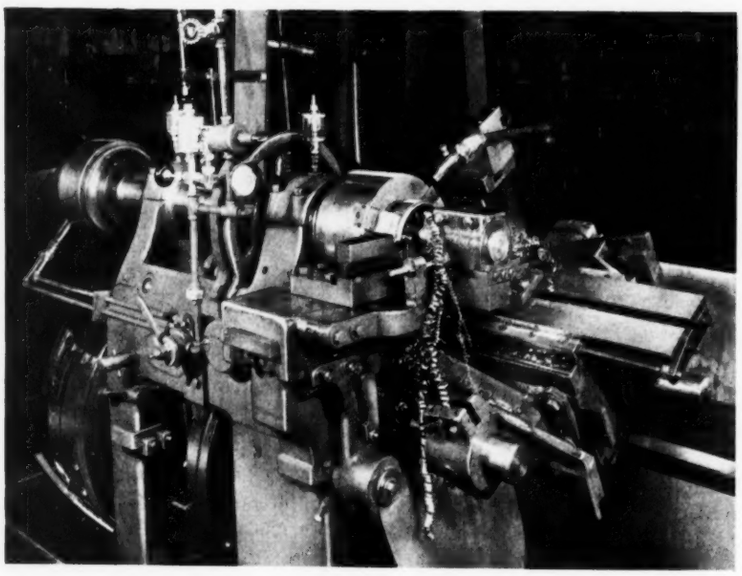


Fig. 2. Machine Shown in Fig. 1 as Re-equipped with Air-operated Chuck and Taper Attachment

The conversion of the small automatic machines, like the one shown in Fig. 1, involved the removal of the old feeding and chucking mechanism. The spindles were then equipped with three-jaw, adjustable air-operated chucks, as shown in Fig. 2. A taper attachment, seen in the foreground of the illustration, was constructed for turning either the tapered outside diameter or boring the inside diameter. After thoroughly overhauling the machines, they were put at work. The pro-

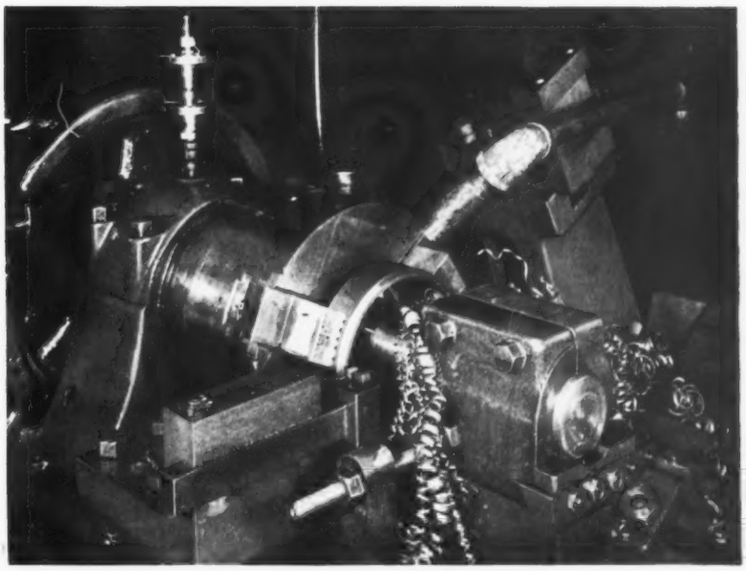


Fig. 3. Boring Taper in Roller Bearing Race on Machine Equipped as Shown in Fig. 2

Fig. 4. Converted Single-spindle Automatic Engaged in Turning Roller Bearing Races

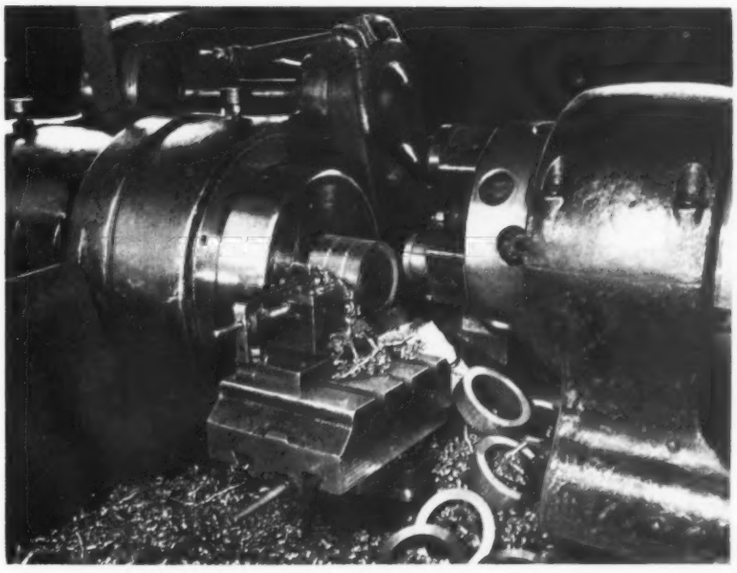


Fig. 5. Heavy-duty Single-spindle Bar Automatic Employed for Cutting off Blank Races to be Bored and Turned on Machines Shown in Figs. 3 and 4

cedure followed in machining the bearings consisted of the three following steps:

1. Slugs or blank races are cut on the larger machines in the manner shown in Fig. 5.

2. The outside diameter is turned on the smaller automatic machines equipped with air chucks as shown in Fig. 4.

3. The inside diameter is bored on a second automatic machine equipped with an air chuck as shown in Fig. 3.

Despite the fact that the three operations are performed on three separate machines, forty of the converted air chucking machines plus twenty of the heavy-duty automatics provided a production capacity equal to that of eighty heavy-duty automatics previously employed.

The first consideration in this conversion program was to meet the increased demand for more of the larger product at any cost; second in importance was the utilization of unadapted equipment; and the third consideration was cost. Naturally the allocating of operations among three different machines entails some additional cost, but the increase is surprisingly small.

* * *

Increase in Production of Plastics

While plastics have been considered as replacement materials for metals under priority control, it is well to recognize that many plastics are themselves now subject to priorities. The production of some plastics during the past year increased as much as 200 per cent. The application of plastics in 1942 automobile models almost doubled. A new acetate sheeting for airplane windshields and windows has been developed which is more weather resistant than the former plastics used. According to a survey conducted by the E. I. du Pont de Nemours & Co., the average number of plastic parts in electric refrigerators is thirty-nine, and the average number in radios is thirty. On large airplanes, hundreds of plastic parts are used. The hope that shortages of metals for use in civilian industry could be, in part, offset by a wider use of plastics is, however, possibly too optimistic. At a recent meeting of the American Society of Tool Engineers, H. M. Richardson, chief engineer of the plastics department of the General Electric Co. stated that while there has been a tremendous expansion in the capacity of plastics plants, there will be little left over for civilian uses after the huge demands of the war industries have been met. Another difficulty, Mr. Richardson pointed out, was that several basic materials —such as formaldehyde—used in the manufacture of some forms of plastics are now on the list of items that will be scarce.

New Processes for Tipping Tools with High-Speed Steel

The General Tool & Die Corporation, 62 Franklin St., East Orange, N. J., has developed two processes for tipping tools with hardened high-speed steel. One consists of brazing a hardened high-speed steel tip to the shank steel without changing the hardness of the tip. The second process consists of arc-welding a hardened high-speed steel tip to the shank without cracking or softening the tip.

These two processes have enabled a large saving to be made in the amount of high-speed steel required per tool, since only from 5 to 10 per cent of the high-speed steel needed to make a solid tool is required when the tools are tipped. A great majority of these tipped tools are produced from high-speed steel scrap pieces—that is, pieces of high-speed steel that have become too short to use in a tool-holder, broken high-speed steel shanks, etc.

One particularly successful application of these processes has been in the use of the stub ends of dovetailed high-speed steel forming tools that have become too short to hold securely, or forming tools that have broken dovetails. In such cases, it is possible to make two tipped tools from the scrapped or broken tool, since only half of the length of the solid tool can be used for cutting purposes, if mounted in a holder, the balance being employed for clamping or holding purposes. In this way, a large number of broken or scrapped dovetailed high-speed steel forming tools have been reclaimed and quickly put back into service.

Another important aspect of the new processes is that they have made it possible to continue to provide medium- and high-cobalt high-speed steel to customers sending in such steel scrap for tipping. For instance, one firm made use of solid 3/4- by 1 1/4- by 8-inch, 8 per cent cobalt high-speed steel tools. These tools were used until they were about 5 inches long, when they were too short to use any further. These short shanks are now used to make tipped tools, each short shank having enough material for twelve tips. High-cobalt high-speed steel can no longer be bought by this customer, but he can still continue to use tools of this character for a long time to come, by using up the scrap.

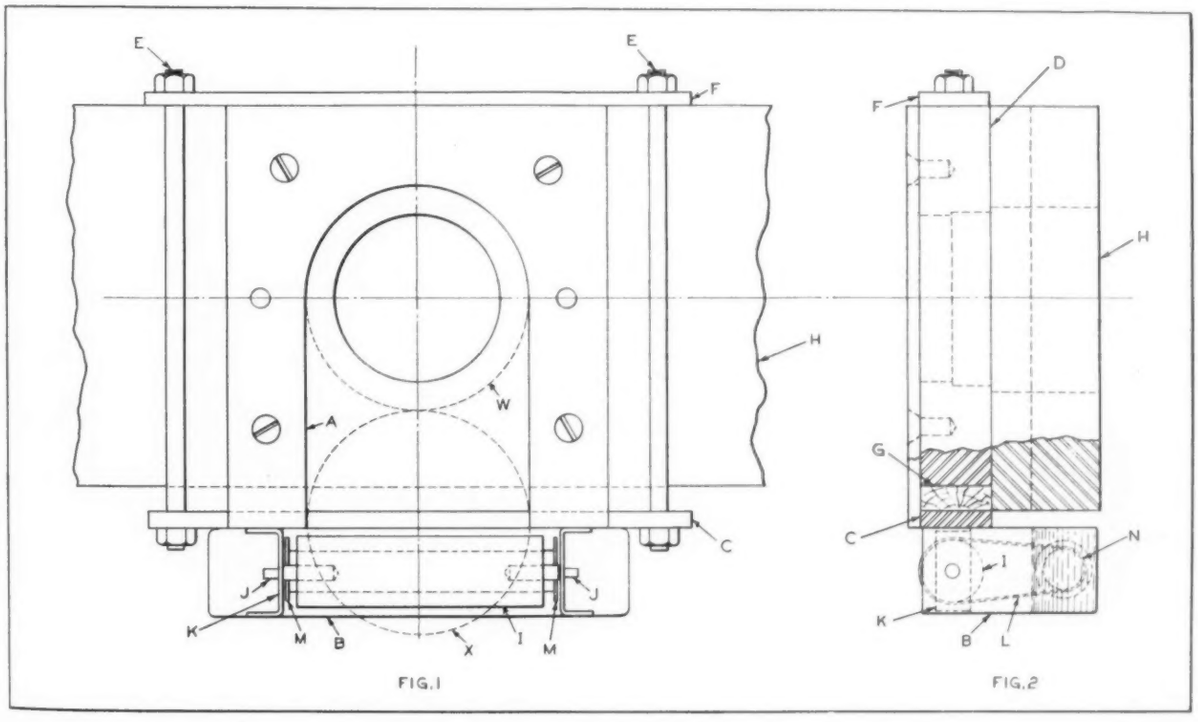
Delivery of tools has been expedited in many cases by the new processes, because the tipped tools can be supplied much quicker than the high-speed steel needed for solid tools. It is believed that these new methods of making high-speed steel tools, for which patents have been applied, will be found advantageous even when the present shortage of high-speed steel is no longer a factor.

Drawing Die Equipped with Automatic Lubricating Device

By GEORGE WILSON, Mankato, Minn.

A push-through type of die for drawing a shallow cup from 0.075-inch mild steel stock is shown in the accompanying illustration. In the original design, the blanks were located over the die by means of the usual circular nest, into which they were dropped. Lubrication was accomplished by dipping the blanks in a pan of oil. The paint-brush method was also tried. These methods, however, were slow and wasteful of oil.

The improved die, shown in Figs. 1 and 2, was made with nest *A* open on one side so that the blanks could be slid into it in the manner indicated in Fig. 1. Blank *W* is held in place over the die by the following blank *X*, shown by the dotted lines. The operator presses against the following blank *X* with the side of another blank held in his hand ready to be slid into nest *A* as soon as the punch ascends. A light blow against the side of the blank carries it into the nest over the die. With this method of feeding



Push-through Drawing Die Equipped with Blank-lubricating Device

the die, the operator need not place his fingers beneath the punch or use a suction cup or other blank-holding device.

Automatic lubrication of the blank is obtained by means of the attachment shown in the illustration, in which *B* is a lubricant reservoir produced by folding thin sheet stock and soldering the seams. A steel strip *C*, soldered to the reservoir and extending across die *D*, provides means for attaching the reservoir to the die with bolts *E* and strip *F*. Strap *C* is flush with the face of die *D*. A wood filler *G* prevents oil from running down between the reservoir and the die, and also permits the reservoir to clear die-shoe *H*.

Trunnions *J* of the wooden roller *I* are carried in bearings *K*, soldered to the reservoir. The trunnions have shoulders which prevent the roller from dragging too heavily against the bearings. A thin cloth belt *L*, about the same width as the blanks, is carried on roller *I*. The belt is held down in the oil by means of steel roller *N*, which is provided with end flanges *M* that keep it in place.

Belt *L* is flush with the face of the die and so positioned that the surplus oil is scraped from the blanks and forced back into the reservoir by strip *C*. The punch is oiled occasionally by pulling one of the blanks back from the roller and turning it over, so that oil is applied to both sides. A commercial drawing oil is regularly used, but machine oil with an addition of white lead also gives good results.

Equalizing Multiple Clamping Device for Milling and Grinding Fixtures

By C. and D. GOLOSMAN, Brooklyn, N. Y.

In machining large quantities of small parts, it is often convenient to load a number of pieces in a suitably designed fixture for simultaneous milling, shaping, or grinding operations. Usually, slight variations in the thickness of the parts cause some of them to remain loose after clamping when a plain jaw type of clamp or vise is used. This may result in broken cutters and tools, as well as spoiled work.

In order to overcome this difficulty, the writer developed an equalizing multiple clamping device for quick-acting fixtures. Fig. 1 shows the application of this device to a milling fixture. The same principle can, of course, be applied to a fixture installed in a vertical position for clamping the work sidewise when the top surface of the work is to be kept clear for machining. The device can also be applied to machine vises such as shown in Fig. 2.

The plan and side views in Fig. 1 show the device in detail as applied to a

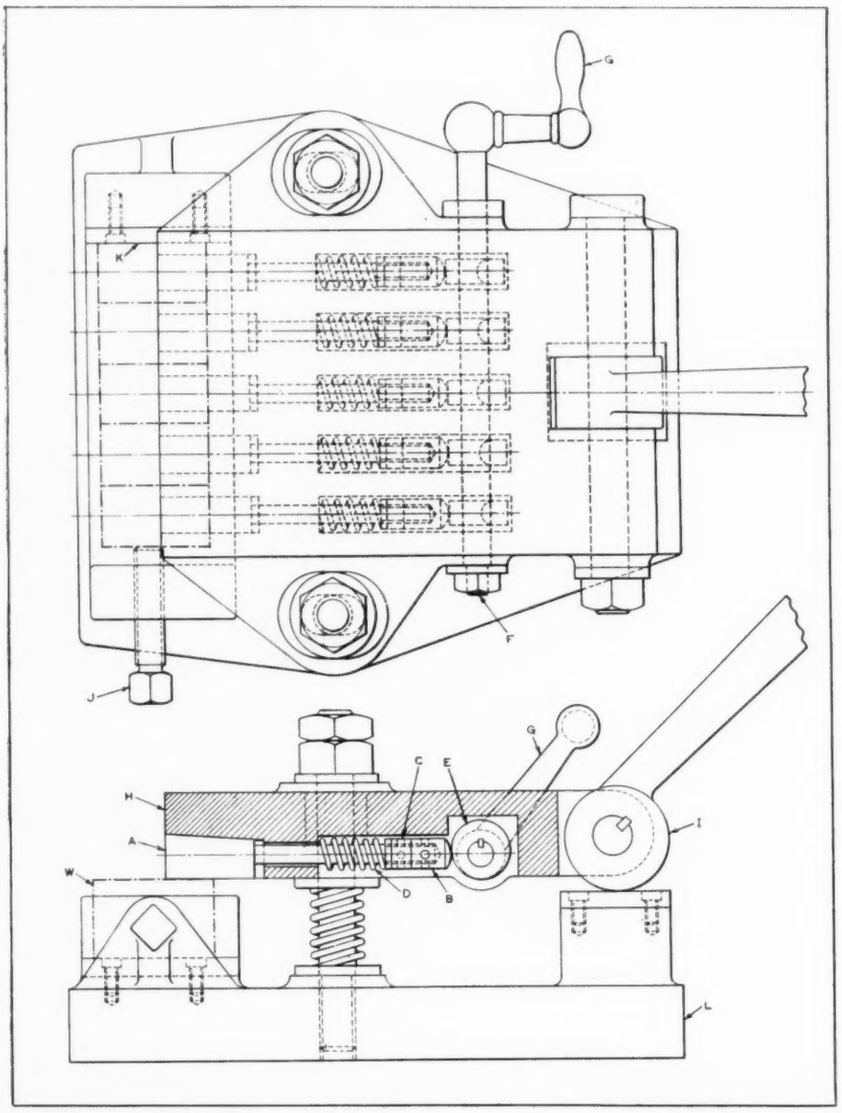
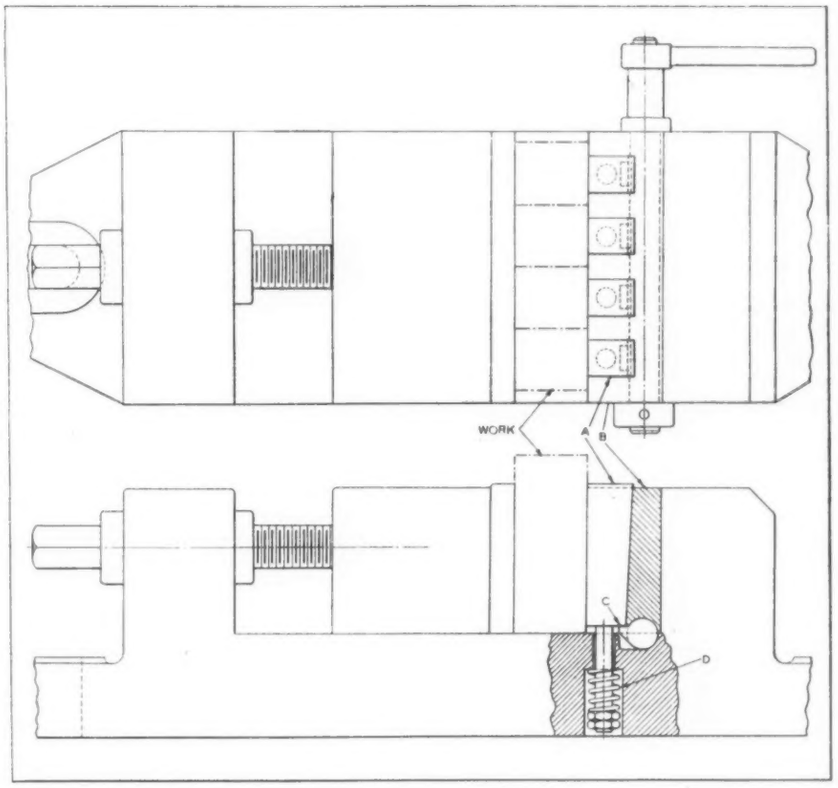


Fig. 1. Milling Fixture with Equalizing Clamping Device Designed to Hold Five Pieces Securely, Regardless of Variations in Height

Fig. 2. Machine Vise Equipped with Equalizing Jaws for Holding Four Pieces



milling fixture. It consists of wedges *A* with threaded caps *B*, check-nuts *C*, springs *D*, eccentrics *E* held on shaft *F*, and handle *G*. The wedges, springs, and eccentrics are confined in slots milled in clamping plate *H* of the fixture.

After loading the fixture with parts *W* to be machined, handle *G*, operating eccentrics *E*, is raised to push wedges *A* outward against the action of springs *D*, thus bringing the wedges to their starting position. Eccentrics *E* work directly against caps *B*, threaded on the shanks of wedges *A*. Clamping plate *H* is then brought down on the parts by means of the cam-lever *I*.

Pushing handle *G* down causes eccentrics *E* to withdraw from caps *B*, thus releasing wedges *A*. Springs *D* then force loose wedges *A* inward. This movement of the wedges compensates for the slight variations in thickness of the parts to be machined and provides equal bearing pressure on the individual pieces. Finally, lever *I* is tightened firmly to complete the clamping action. The endwise clamping of the parts can be accomplished by tightening set-screw *J* to force the work against end *K* of fixture base *L*.

In the case of the machine vise shown in Fig. 2, the equalizing multiple clamping unit is contained in the hardened tool-steel plate or special jaw *B*. Wedges *A* are confined in the milled slots of jaw *B*. This jaw is fastened to the vise cheek with screws, so that it can be easily removed. The shaft with integral projections *C*, which serve to lift wedges *A* against the action of springs *D*, is installed in a bearing between the base of the vise and jaw *B*.

The holes which receive the studded ends of wedges *A* and springs *D* are drilled and counterbored in the base of the vise. The action of the equalizing clamping device is similar to that of the milling fixture shown in Fig. 1. After the four pieces of work have been lightly clamped in place, the lever operating the shaft with projections *C* is moved upward to allow springs *D* to draw wedges *A* down, so that uniform clamping pressure is applied to all four pieces of work when the clamping screw is tightened.

Extinguishing Magnesium Fires

A new method of instantly extinguishing magnesium fires in war material plants has been developed at the plant of the Vega Aircraft Corporation, Burbank, Calif. Several minor fires in the lathe and milling machine departments in the Vega machine shops have been extinguished by the new method. The extinguishing agent, which is entirely harmless both to human beings and to machine equipment, is a combination of several viscous liquids and carbon dioxide. Upon contact with burning magnesium, it reacts in such a manner that the fire is extinguished instantly. The cost is low and the fire extinguishing means can be applied by anyone. For further information, communicate with the News Bureau, Vega Aircraft Corporation.

* * *

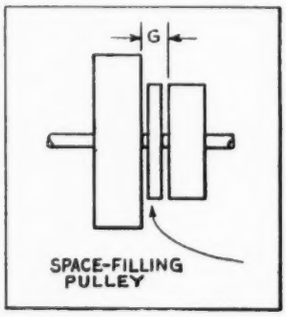
To aid in conserving steel for American war production, the Standard Oil Co. of Indiana has appealed to customers who receive lubricating oils and greases in steel barrels to return the barrels when they are empty, so all available barrels can be kept in circulation and the use of steel for barrels reduced to a minimum. On all steel barrels the company now attaches a red, white, and blue label reading: "Do your part—We will do ours. Return drums as soon as empty. Keep 'em rolling for defense."

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work

Space-Filling Pulley Eliminates Hazard

If the space between two pulleys indicated as *G* in the accompanying illustration is less than 1 1/2 times the width of the widest adjacent belt, the operating conditions may be dangerous. In the event that the belt runs off its pulley, it is likely to become caught between the pulleys and be broken or ruined, and it may pull the shafting, pulleys, and hangers down on the workers below.



Method of Preventing Belt from Catching between Pulleys

This condition is easily remedied by placing a pulley in the vacant space, as shown in the illustration, so that the belt cannot drop into the space. The diameter of this additional pulley should not be less than that of the smaller one and not greater than that of the larger pulley.

Also, when a belt runs off a pulley that is located adjacent to a hanger, the situation is hazardous unless provision is made to prevent the belt from catching between the hanger and the pulley. This can usually be done by attaching a hook or guard to the hanger in such a way that if the belt runs off the pulley, it will drop on the hook or guard, and thus be prevented from becoming entangled.

Newark, N. J. W. F. SCHAPHORST

Reducing Size of Spline on Heat-Treated Work

Recently the writer had occasion to reduce the size of a spline on a crankshaft after it had been heat-treated. It was impossible to remove, by remachining, the 0.0005- to 0.00075-inch of stock required to permit the inspection gage to slide over the part. It appeared necessary, therefore, to either scrap the piece or devise some suitable means of removing the surplus material. Since scrapping the work represented a loss of about $300, the latter alternative was chosen, with successful results.

After the work was thoroughly cleaned, it was coated with wax except where stock was to be removed. The piece was then dipped in the plating-room tank containing a weak acid solution ordinarily used for cleaning scale from work. After about ten minutes' immersion, the piece was taken out and carefully scratch-brushed on the surface treated to remove any oxidation. This process of immersion and scratch-brushing was then repeated. About thirty minutes of actual immersion was found sufficient to remove the surplus stock. Repeated scratch-brushing is necessary because, otherwise, the uneven action of the acid would cause pitting. While pitting would not harm some types of work, it was important in this case that the surface have a high finish.

Newark, N. J. DONALD A. BAKER

* * *

Industrial Motion Pictures for Educational Purposes

Motion pictures produced by the United States Steel Corporation have proved of great value in training courses throughout the United States. During the past year more than two million people have seen the United States Steel motion pictures. "The Making and Shaping of Steel" is the latest film produced by the corporation. This film tells the story of steel-making in seven reels, from the time the ore is mined until the finished product leaves the mill. The scenes for this picture were taken in a great many of the plants of the United States Steel Corporation, and show a great variety of operations that could not be seen by a visit to any one plant. The films may be borrowed without charge by communicating with the company's offices in New York, Chicago, Pittsburgh, Cleveland, Birmingham, or San Francisco.

* * *

Business men now fully realize that to win the war there can be no "business as usual." It is also of importance that our statesmen remember that this is no time for "politics as usual."

Extreme-Pressure Lubricants for Industrial Use

Abstract of a Report by H. A. McConville, Chairman of the Lubrication Committee of the American Gear Manufacturers Association, Presented before the Twenty-Fourth Semi-Annual Meeting of the Association

IN all fields of activity, advances are being made that extend the usefulness of materials. This also applies to lubricants for gears. For many years either straight mineral oils or oils compounded with animal oil additions were used for this purpose. They proved successful, or at least satisfactory, for the majority of applications where the requirements were simple. In most cases, the loads were moderate, the apparatus ran fairly cool, and there were no other complications.

Then the automobile industry began building cars capable of operation at higher speeds, and decided that car bodies should be closer to the ground to improve the appearance and provide greater safety. One of the results was that the sizes of the gears for rear ends of cars were reduced and the hypoid gear was developed. With the increase in speed and power output, the ordinary oils available were not capable of carrying the loads, so extreme-pressure (E.P.) lubricants came into existence.

Early Applications of E. P. Lubricants

Packard used the first hypoid gears about 1924. The company had a special lubricant which gave very good results with these gears. However, when car owners bought their own oil for rear axles at filling stations, it was discovered that the gears were badly scored. The special oil was a lead soap-corrosive sulphur compound, the type now considered the most successful of powerful E.P. lubricants for automotive gears. Since that time, many different types have been developed, some of which are highly corrosive, and others that have only a mild action on the metal. They are, therefore, divided into two general classes—powerful E.P. or hypoid lubricants, and mild E.P. lubricants.

Although we are not considering automotive applications here, it is of interest to dwell on those findings of the automobile industry that can be used to advantage in the industrial field. We might define E.P. lubricants as lubricants which, under certain operating conditions, will permit greater loads or speeds than can be carried with ordinary mineral oil of similar viscosity. This would include saponifiable oils, such as lard and castor oil; but in referring to E.P. lubricants, we think of them as having load-carrying ability superior to that obtainable with saponifiable oils.

Theories Advanced Relating to Load-Carrying Capacities of Lubricants

There have been many theories advanced as to why E.P. lubricants will sustain heavier loads. The earliest beliefs were that some types of lubricants in thin layers were tougher than others, and so would support heavier pressures when placed between bearing surfaces. Later theories, supported by evidence, advanced the idea that the effectiveness of an E.P. lubricant does not depend on the film strength of a thin layer of oil, but upon its ability to form a chemical compound on the bearing surfaces. These compounds, formed by chemical attack on the bearing metals, produce a surface that will withstand heavier loads. As this surface comes from material in the lubricant reacting with the bearing metals, it must be formed rapidly enough to replace that which is worn off Also, the film formed will vary with the chemical composition of the bearing, so that an E.P. lubricant which gives good results in one case may fail to give satisfaction in another if the bearing metal has a different chemical analysis.

On the basis of this theory, an E.P. lubricant, to be entirely satisfactory, must, therefore, (1) contain a material capable of combining with the bearing metal to provide a special higher-load bearing surface; (2) form this surface at the temperature at which the gears or bearings operate under the particular load and speed desired; (3) form the surface in sufficient amount to create a film of the required load-carrying ability under the operating conditions.

Several laboratory machines have been developed to test the properties of these E.P. lubricants, but the results obtained on these various

machines have not agreed very well. It is believed that this is due to the difference in the rate of film formation which, of course, varies with differences in the materials and in the operating technique for each machine. Therefore, the final answer is a trial of the lubricant in the apparatus it is to lubricate under actual operating conditions.

Some engineers do not agree with the preceding theories. They point out that the hypothesis involving formation of a chemical compound on the bearing surface seems far-fetched when applied to helical or herringbone gearing. The chief virtue of a lead-soap compound, they say, is the protection against pitting, which they surmise arises from some combination of properties of the lubricant and characteristics of the conjugate gear action. The formation of a very thin chemical compound does not satisfactorily explain the increased resistance to pitting.

Application of E.P. Lubricants to Industrial Uses

Probably one of the first users of the E.P. lubricants was the Timken Roller Bearing Co. Back in 1929, this company had problems in steel mill gear operation that were solved by the use of E.P. lubricants. The types used then were the lead-soap and lead-soap-sulphur compounds, and also a mineral oil to which had been added from 15 to 20 per cent of a sulphur-chloride base oil. The last-mentioned compound produced some discoloration, but apart from this, these lubricants gave very good satisfaction. Some steel mill operators feel that the lead soap has a cushioning action and will lessen gear noise. The first lead soaps made, using lead oleate, had a tendency to separate; but this has been overcome by the use of lead naphthenate to replace the oleate.

There are probably many companies in the country that have used E.P. lubricants for industrial applications for a long time, but it is not easy to obtain data relating to their performance. When and why should these lubricants be used for gears? The principal application, of course, would be where gear teeth are subjected to very heavy loads. Here a mild E.P. lubricant is used to avoid possible scuffing, or excessive wear, and abrasion.

The lead-soap compounds, according to some, give additional protection against pitting. When ordinary straight mineral oils will not do the work, these special lubricants may prove satisfactory. Gears that run hot are frequently a cause for complaint. This heating may be due to using an oil of too high viscosity, in which case the remedy is obvious. But if it is due to overload, the use of an E.P. lubricant may allow cooler operation, as well as reduce the wear on the gear teeth. If the cause of high temperature is some mechanical fault, however, the only solution is to make the necessary corrections. Looking to the future, it may be possible to build gear units of increased ratio or carrying capacity without increased size. This opens up greater possibilities for single-reduction units.

What Types of E.P. Lubricants are Most Suited for Industrial Applications?

The field of available E.P. lubricants for all purposes includes the following classes:

1. Mineral oil + lead soap + active sulphur compound.
2. Mineral oil + lead soap (with natural sulphur compounds in the base oil).
3. Mineral oil + lead soap + inactive sulphur compound + chlorine compound.
4. Mineral oil + active sulphur compound + chlorine compound.
5. Mineral oil + inactive sulphur compound + chlorine compound.
6. Mineral oil + active sulphur compound.
7. Mineral oil + inactive sulphur compound.
8. Mineral oil + chlorine compound.
9. Mineral oil + phosphorus compound.
10. Mineral oil + chlorine compound + sulphur compound + phosphorus compound.

Almost all of these types contain, in addition, a certain amount of saponifiable oil. The large number of varieties available is no cause for confusion. Fortunately, we do not have to consider the numerous varieties developed for the automotive industry, as only one class is in common use in the gear industry—namely, the mild E.P. lead naphthenate or oleate compounds. It is the feeling of gear manufacturers who have tried these E.P. lubricants that the powerful hypoid type represented by mineral oil + lead soap + active sulphur compound is not needed for industrial work.

Desirable Properties of an E.P. Lubricant

An ideal E.P. lubricant should possess the following properties: (1) High enough E.P. value to carry the desired load; (2) low abrasive action; (3) low chemical activity; (4) high stability; (5) high fluidic properties.

How can we determine that a lubricant meets these requirements? If the load-carrying ability is not high enough, the gear teeth will be scored. The abrasive quality is measured by the amount of wear on the gear-tooth profile and by the wear which takes place in the bearings. Another way to determine this quality is to examine the oil for metal content. Chemical activity is judged by the appearance of the metallic surfaces in contact with the lubricant and by analyzing the oil for acidity and corrosive compounds.

Stability is most important, and on this point many E.P. lubricants vary widely. They may oxidize rapidly and thicken, but there are also cases where they have given ten years of service. Some may become highly acid and corrosive or rancid at high temperatures. Others may suffer a loss in load-carrying capacity, or may become highly abrasive, or even break down entirely and carbonize. The sludging of oil is a good indication of lack of stability.

Precautions to Observe in the Use of E.P. Lubricants

The principal precaution to observe in using these lubricants is not to mix the various types or brands. The chemical composition of each is different, and it is highly probable that mixing will produce a chemical reaction, with resulting sludge or other undesirable features. If a change is to be made to a different type of lubricant from the one being used, it is essential that the gear-box or housing be thoroughly drained and flushed with a flushing oil.

Most E.P. lubricants emulsify when churned with moisture. Therefore, they should not be used where there is any possibility of moisture getting into the gear-box or gear housing or where extremely high humidity exists. Their use is not recommended in the presence of bronzes or other copper alloys. If we assume that, in general, they are not as stable as oils to which no additions have been made, then they logically should be changed at intervals comparable to those set up for ordinary oils, or every six months.

The safe upper operating temperature of these E.P. lubricants is above the temperature recommended for operating gear units; therefore, normal operating heat should not cause a breakdown of these oils in gear units.

Federal Specifications for a Universal Gear Lubricant

Recently, a proposed Federal specification for a universal gear lubricant has been drafted. This would cover all the Government applications for automotive and industrial use. First a mixture is made containing between 70 and 80 per cent, by weight, of chlorinated paraffin wax (40 per cent chlorine), the remainder being either dibenzyl disulfide or chlornaphtha xanthate (30 to 35 per cent chlorine). Then the E.P. lubricant is made by blending 10 per cent of this mixture with 90 per cent mineral oil, by weight. Such a lubricant would not be classed as the powerful hypoid type, but would be one of the milder types. The two compounds could be mixed without causing any harm—something that is not true of the majority of E.P. lubricants. Over 80 per cent of the lubricant manufacturers make such a universal lubricant.

However, some engineers who have had broad experience with E.P. lubricants advocate the lead naphthenate type as having given very satisfactory service in the past and believe, therefore, that it is the only one to be considered at present. They state that every mill drive they have built in the last ten years has used either a lead oleate or naphthenate lubricant. In practically all of these instances, the lubrication system was designed to handle this type of compound successfully.

Other mill builders, in the heavy-duty field, believe that lead naphthenates should be used, because of the protection they afford under emergency conditions, and because, where space limits the size of the gears chosen, much longer life is obtained. The newer types of lubricants may have possibilities, but they prefer not to use them until a good record of field service has been established for them.

Some engineers favor lead sulphur and sulphur chlorine, as well as straight sulphur type oils. The Timken Roller Bearing Co. has obtained satisfactory results from the sulphur chloride base or blends of mineral oil and the fatty oil-sulphur-saponifiable bases, and reports that some of the steel companies are using the leaded compounds successfully.

* * *

Volume for Victory—A Fitting Slogan for Manufacturing Plants

The workmen at the Buffalo, N. Y., plant of the American Car & Foundry Co., recently held a contest to decide upon a slogan for the plant, which is engaged in making shells for the United States and Allied Governments. Henry Gorga, a machinist, received the prize of fifteen silver dollars presented by the management for his winning slogan "Volume for Victory." When approached for information about himself, he said that he was not a very interesting person—he was "just another American."

The "Volume for Victory" slogan will be placed at the top of the production indicator in one of the company's buildings where, by red lights, is shown the daily production of shells.

* * *

Women Welders in Great Britain

It has been discovered in Great Britain's war factories that women make good welders. This means that they have not only been trained to become efficient operators of fusion-welding equipment, but that they have also shown ability as electric arc welders.

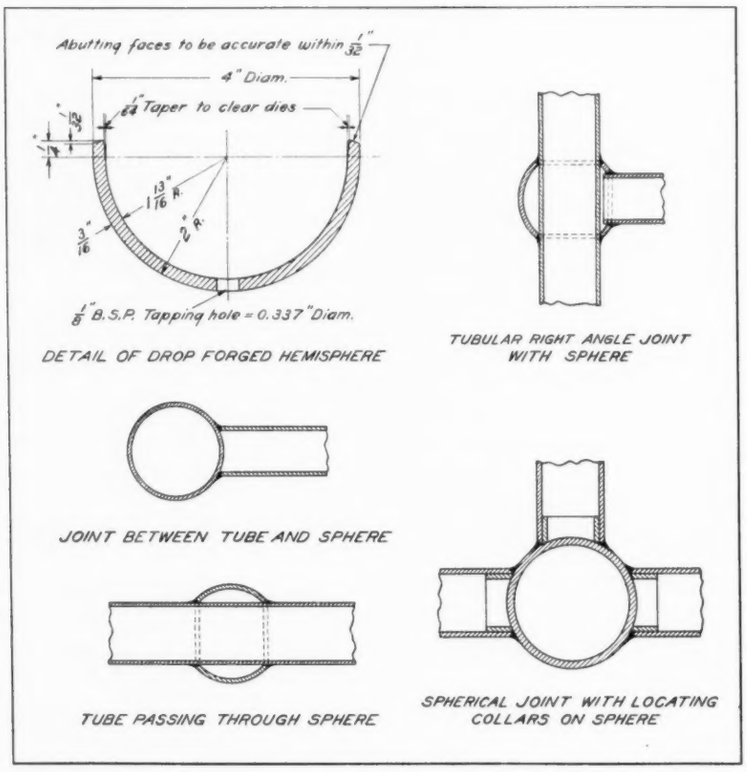
Spherical Joints for Welded Tubular Structures

ONE of the unusual features of the Model Basin at Carderock, Md., for testing ship models of all types is a towing carriage whose tubular members are joined by hollow spheres. These joints are made by welding the ends of the tubular members to the outside of the spheres at the desired angle. The great advantage of this construction is that it permits many of the members to be cut off perfectly square where they join the sphere. This saves a considerable amount of time in machining to the exact angles necessary when the more conventional joints are used. The welding required at each spherical joint is also reduced considerably, with a corresponding decrease in time, cost, and locked-up stresses.

This is believed to be the first time that the spherical-joint construction has been used in such a large structure. A comprehensive study of the nature and advantage of this method of joining was embodied in a prize-winning paper written by A. J. Burstall, Harold Kennedy, and R. A. Smith, for the Second Lincoln Arc Welding Prize Competition sponsored by the Lincoln Electric Co., Cleveland, Ohio. The authors pointed out that the round-tube section was seldom practical in structural work in the days when joining was restricted to bolts or rivets or various types of mechanical fittings. Because riveted and bolted joints are necessarily lap joints, flat surfaces have to be provided for all connections; but the advent of welding has provided a means of joining round sections which is even more satisfactory than riveting or bolting. For one thing, it permits making a satisfactory joint without any change of shape along the length of the tube.

Welding has been applied widely in all kinds of pipe lines, and has been accompanied by the production of a vast assortment of special fittings to facilitate change of direction or the union of two or more pipe lines at varying angles. The largest application of the tube section for structural purposes is found in the construction of airplanes, where the practice is to weld the tubes directly to one another after having shaped them to fit. In some applications, designers have resorted to the method of slotting the tubes to take a connecting plate which passes through the center plane of the tubes being joined.

All of these methods of assembling tubular structures by welding are practical enough to have earned wide acceptance. They involve some cost factors, however, which, when combined with the relatively high cost of tubular members per unit of weight, as compared with steel plates or other structural steel sections, have prevented a wider adoption of the tube section for structural use. The spherical joint was devised to avoid some of the disadvantages of the more common weld assembly methods and to reduce the total cost of the finished structure. It provides for uniting the tubular members by welding them to a common intermediate member in



Various Types of Spherical Joints for Tubular Members and Details of Hemisphere from which the Spheres are Constructed. Advantage of This Joint is that Tubing Ends Require No Special Preparation other than to be Cut Square

the form of a sphere, to the surface of which each of the tubular members is joined, the line of contact being a circle. It is thus possible to reduce the welding operation required to a single type, which is of the simplest kind.

The authors have found that the most convenient method of forming the intermediate member is to join two die-stamped hemispheres. The diameter of the spherical member should exceed the diameter of the widest tube in the joint by at least 50 per cent. It is, of course, possible to join several tubes through the medium of a single sphere. Also, the joint between two tubular members may be made at an intermediate point along the length of one of them by providing a spherical collar, the internal diameter of which is such as to allow it to be passed over one of the tubular members and to be welded to it, as shown in the accompanying illustration. In this case, the second tubular member is affixed to the surface of the sphere in the normal manner. There are numerous modifications possible.

One of the most important advantages of this joint is that the expense of preparing the ends of the tube for welding is very much reduced, since they are in all cases cut off square. The section of the weld between tubes and spheres is always the same, and, hence, the welding operation itself and the subsequent inspection of the weld are both greatly simplified. Furthermore, assuming that the end of the tube is cut square, the welder can be certain that if the tube is touching or at the same distance from the sphere at all points of its circumference, then the center line of the tube must pass through the center of the sphere. Thus, any eccentricity due to misalignment is avoided.

When a number of members come to a common point, overlapping of the tubes can be avoided by using a large sphere as the center of a common joint and joining all the tubes to its surface. It will then be possible to make all the welds on the surface of the sphere without excessive overheating. A further advantage is that there is no sudden change of direction in the lines of stress, and, hence, no stress concentration at the joint.

* * *

Horsepower Required for Marine Purposes

According to Ralph Kelly, vice-president in charge of sales of the Westinghouse Electric & Mfg. Co., the horsepower of the steam turbines now being built to drive the nation's two-ocean navy and expanded merchant marine, amounts to about one-half the present installed turbine capacity of the entire public utility industry in the United States.

Screw-Thread Standards for Army and Navy Work

Many thousands of widely separated plants making interchangeable parts to fit into the planes, tanks, guns, and other equipment produced for the Army and Navy Departments are likely to find the recently published "Standards Handbook H28—Screw-Thread Standards for Federal Services," of considerable assistance.

This publication has been brought out by the Interdepartmental Screw-Thread Committee representing the War, Navy, and Commerce Departments. It supersedes Handbook H25 and includes a number of revisions and additions. Its purpose is to present complete dimensional data, upon which specifications can be based for a wide variety of threaded products needed by the Government. The publication carries the formal approval of the Secretaries of War, Navy, and Commerce.

The standards set forth in the publication are mandatory, except when need for deviation is requested in specific instances. For the most part, these federal standards conform to generally accepted commercial standards, with some exceptions made necessary by the particular needs of the Government. Copies of the Handbook can be obtained from Superintendent of Documents, Washington, D. C., at 35 cents each.

* * *

New Use for Dowel-Pins

John Nowell, General Electric engineer, had ninety days in which to construct the first large electric plant in the Belgian Congo. On location, he was checking the many parts packed in crates and boxes to see if everything was there. His tally disclosed that nothing was missing—except the dowel-pins. The whole camp was searched, natives were questioned, but not a single steel dowel-pin was found. It was too late to get replacements. So, with some scrap iron rod, improvised iron tools, and unskilled help, a new set of pins was manufactured, and the job was completed on time.

Months afterward, a visitor to a half-savage tribe in the Belgian Congo found men and women alike wearing a new type of nose ornament. Thrust through the cartilage of the nose, gleaming and twinkling in the African sunlight, each proud native wore one of John Nowell's missing dowel-pins.

* * *

Industry, in the past, when left free to function efficiently and on its own initiative, always delivered the goods. How about giving industrial leaders a chance now?

Choosing the Right Lamp for Industrial Lighting

By H. S. BROADBENT
Commercial Engineering Department
Westinghouse Lamp Division

THERE are available today for industrial lighting purposes four types of electric lamps—the incandescent, mercury vapor, fluorescent, and rectifying fluorescent. The proper selection of one of these types for a particular industrial lighting installation depends upon a number of factors, such as color of light desired or tolerated, available height for location of fixtures, number of hours of anticipated operation per year, initial cost, frequency of power failures experienced, accessibility for replacement, and so on. Before discussing these factors in detail, however, a brief description of each type of lamp will perhaps be of interest.

The incandescent type is the common pear-shaped lamp familiar to everyone, in which an incandescent filament is the light source. The high-intensity mercury vapor type has been used for industrial lighting since 1934, and is a tubular lamp about 1 foot long which produces a greenish light by a continuous electrical discharge through its mercury-vapor filled interior.

The fluorescent lamp, which is now being introduced for both industrial and domestic use on a rather extensive scale, is also tubular in shape, but considerably longer than the mercury vapor type. It, too, is a mercury vapor lamp, but the electrical discharge is so regulated as to produce radiations, which, instead of being in the visible light range, are largely in the ultra-violet range. These radiations impinge on a phosphor compound coating on the inside of the tube and cause it to fluoresce, giving off visible light. Various phosphor compounds are used to produce different colors when fluorescence occurs. The white compound, for example, gives off light which approximates daylight in character.

The rectifying fluorescent lamp is similar to the fluorescent type, except that it has two anodes at one end and a cathode at the other, and acts as a full-wave rectifier. The current from the alternating-current source is rectified and flows through the lamp in one direction.

From the standpoint of cost, the mercury vapor lamp might be the logical choice if the ceiling or roof were high enough to permit the most efficient location, and if the greenish color of the light were not objectionable, as it might be, for example, where close color discrimination has to be maintained in the product undergoing manufacture. Thus, mercury vapor lamps might be a wise selection for a foundry or metal-fabricating shop installation.

If, however, mounting height or color quality ruled out the mercury vapor lamp, what next? Then the decision would be between the incandescent and the two types of fluorescent lamps. Two questions would have to be answered: How many hours is the installation going to be operated per year? What is the cost of power? The initial cost of fixtures and auxiliaries for both types of fluorescent lamps is greater than for incandescent lamps, but the cost of power to operate them is less for the same amount of light. So it becomes a question of balancing one factor against the other to fit the conditions.

Table 1. Comparison of Light Output, Cost, and Life of Four Types of Lamps

Factor	Type of Lamp			
	Incandescent	Fluorescent	Rectifying Fluorescent	Mercury Vapor
Finish	White Bowl	3500 Deg. White	Ind. White	Clear
Lamp watts	500	40	85	400
Lamp lumens	9600	2100	4000	16,000
Cost (list price less 30 per cent)	$0.84	$0.95	$2.55	$7.70
Lamp life (average hours)	1000	2500	3000	3000
Type of fixture	RLM	Two-lamp RLM	Two-lamp RLM	Low Bay
Cost with auxiliary	$4.00	$16.50	$33.00	$24.00
Auxiliary loss per lamp (watts)	0	8.75	15	40

Table 2. Lighting Investment and Energy Consumption for Comparable Installations

Factor	Type of Lamp			
	500-watt Incandescent	40-watt Fluorescent	85-watt Rectifying Fluorescent	400-watt Mercury Vapor
Number of lamps required	64	292	154	38
Number of fixtures required	64	146	77	38
Cost of fixtures	$256	$2410	$2540	$912
Cost of installation	320	730	385	190
Lighting investment	$576	$3140	$2925	$1102
Cost of initial lamps	$54	$275	$393	$293
Lamp load (watts)	32,000	11,700	13,100	15,200
Auxiliary load (watts)	0	2550	2300	1520
Total load (watts)	32,000	14,250	15,400	16,720

Typical Installation Provides Basis of Comparison

Perhaps it will help to answer some of these questions and to show the relative importance of the various factors that must be considered if the lighting costs with the different types of lamps are worked out for a set of assumed conditions, such as the following: Area to be illuminated, 10,000 square feet; intensity, 40 foot-candles; useful lumens required, 400,000; utilization factor to compensate for loss of light in reflectors, walls, etc., 65 per cent; generated lumens required, 615,000.

The utilization factor will vary for different types of lighting units and for different colors of walls and surroundings, but the value chosen is a representative one for utilitarian lighting of industrial areas. Assuming that the area is such that it will permit any type of lamp to be used to provide illumination of comparable quality from the standpoint of uniformity and glare, the data on lamps and fixtures shown in Table 1, which have been taken from manufacturers' publications where possible, are closely comparable.

From these data it is an easy matter to calculate the number of lamps required to generate 615,000 lumens, the number of lighting fixtures, the lighting load, and, assuming an installation charge of $5 per fixture, the lighting investment, as given in Table 2.

Since the initial investment for mercury vapor and fluorescent lighting equipment is from two to five times that for incandescent lamp lighting, the question of how much the installation is going to be used and the cost of power must be known before the point at which the higher capital charges are offset by the lower power charges can be determined. Depreciation and interest are usually charged against the installation on an annual basis as a percentage of its initial cost whether it is used or not, so that the charge per hour depends upon how many hours the installation is used per year. On the other hand, power and lamps are only consumed when the installation is in use, and their cost per hour of operation is constant, regardless of how many hours the lighting equipment is used per year.

If it is assumed that the initial investment is depreciated at the rate of 10 per cent per year and is charged with 6 per cent for interest, taxes, etc., and that the lighting is used 3000

Table 3. Comparison of Total Lighting Costs for a Typical Installation

Factor	Type of Lamp			
	500-watt Incandescent	40-watt Fluorescent	85-watt Rectifying Fluorescent	400-watt Mercury Vapor
Number of lamps installed	64	292	154	38
Average life (hours)	1000	2500	3000	3000
Number of renewals per year	192	350	154	38
Kilowatt-hours per year	96,000	42,750	46,200	50,160
Interest and depreciation (16 per cent)	$92	$502	$469	$177
Cost of lamp renewals	161	332	393	293
Cost of power at 1 cent per kilowatt-hour	960	427	462	502
Total operating cost	$1213	$1261	$1324	$972
Cost per hour	$0.404	$0.421	$0.441	$0.324

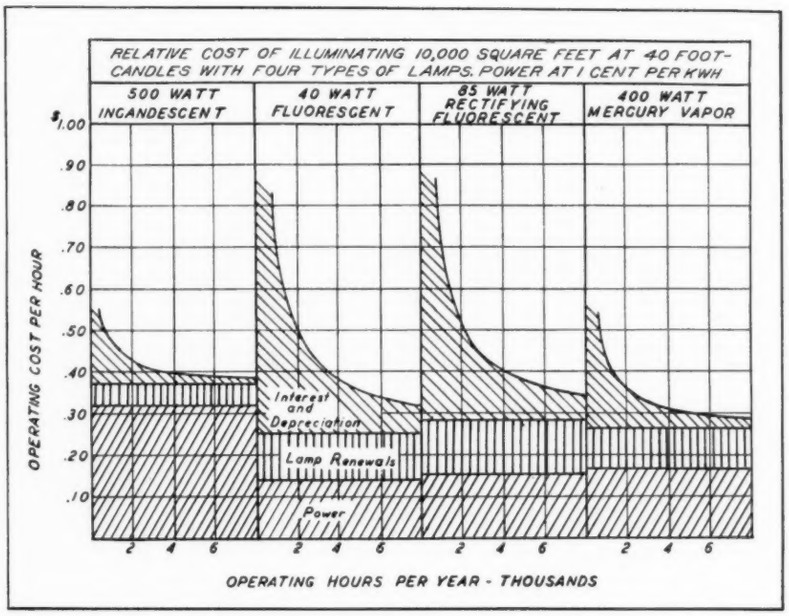


Fig. 1. Comparison of Illuminating Cost Elements for Four Types of Lamps with a Power Rate of 1 Cent per Kilowatt-hour

hours per year with power at 1 cent per kilowatt-hour, it is relatively simple to calculate the total lighting cost for each type of lamp, as given in Table 3.

This provides the basic data from which the lighting cost per hour for a varying number of hours per year can be calculated. The curves in Fig. 1 show the cost broken up into its elements of power and lamp renewals, which remain constant, and the capital charge, which varies with the number of hours the lighting is used per year. These curves are for power at 1 cent per kilowatt-hour; for other power rates, the capital charge and lamp renewal portions would remain the same, while the power portion would simply be changed in proportion to the rate per kilowatt-hour.

In order to make a convenient comparison, the curves representing the four types of lamps may be superimposed on one set of coordinates, as in Fig. 2, to which have been added the curves for 2-cent and 3-cent power. This shows at a glance the point at which one type of lighting becomes more economical than another.

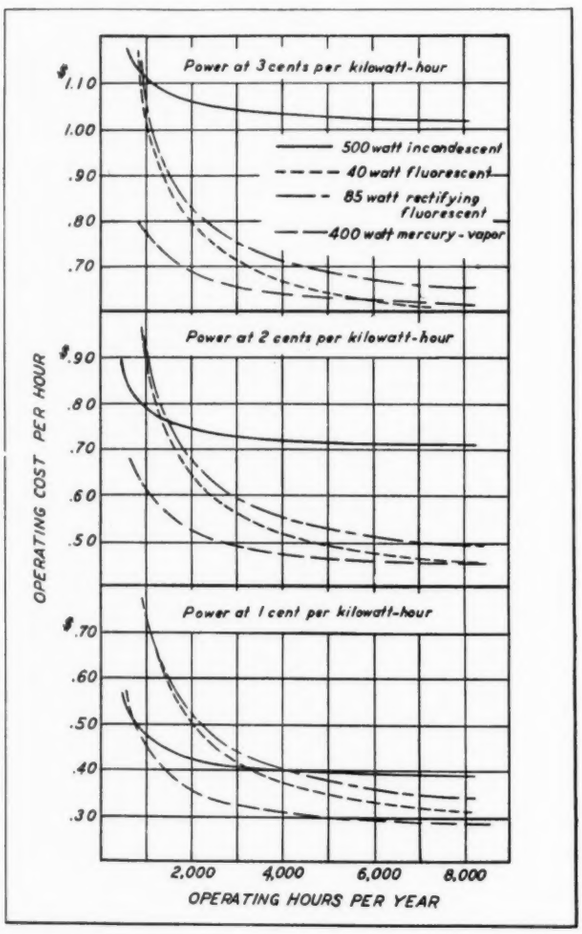


Fig. 2. Comparison of Total Illuminating Cost for Four Types of Lamps at Different Power Rates

The Most Economical Type Changes with Cost of Power

The 400-watt mercury vapor lamps provide the cheapest lighting in practically all cases because of their relatively low initial cost and high efficiency. With a power rate of 1 cent per kilowatt-hour, it requires 3500 hours of operation per year before the lower initial cost and lower lamp renewal cost of incandescent lamps are offset by the lower power cost of fluorescent lamp operation. With a power rate of 2 cents per kilowatt-hour, both types of fluorescent lamps become more economical at about 1500 hours per year of use, and the difference thereafter is pronounced. And, as would be expected, when power costs 3 cents per kilowatt-hour, the fluorescent types are more economical, even if only used 1000 hours per year.

In this cost comparison, the cost of removing burned-out lamps and installing new ones has not been included, because there is such a wide difference among industrial plants, not only in the accessibility of the lighting units, but in the method and class of labor used for renewing lamps, as well as in the manner of treating the labor charges involved. But the cost of renewing lamps is a factor that should be considered, in any individual cost analysis, because it may

Table 4. Typical Characteristics of Four Types of Electric Lamps

Characteristic	500-watt Incandescent Lamp	40-watt Fluorescent Lamp	85-watt Rectifying Fluorescent Lamp	400-watt Mercury Vapor Lamp
Color Rendition	Good, but deficient in blue; must be corrected for true white light	Close approximation of white light. Slight excess of yellow, green, blue, and violet	Close approximation of white light. Slight excess of yellow, green, blue, and violet	Marked color distortion; red objects appear black
Mounting Height	May be placed at any reasonable height	May be placed at any reasonable height	May be placed at any reasonable height	Ought not to be mounted less than 16 feet above floor
Starting Time after Closing Switch	Instant	2 to 3 seconds delay	1 second delay	Instant, but requires 3 to 5 minutes to reach full output
Restarting after Power Interruption	Instant	2 to 3 seconds delay	1 second delay	Requires 5 to 10 minutes to cool before arc re-establishes
Stroboscopic Effect	Practically none	Not noticeable with two-lamp unit	Practically none	Noticeable in case of rapidly moving objects
Power Factor	100 per cent; no correction required	Two-lamp units 95 to 100 per cent. Single lamp units may be corrected to 90-95 per cent	Units are corrected to 90-95 per cent	Units are corrected to 90-95 per cent
Starter Switch	None required	Good starter switches are available	None required	None required
Removal after Failure	Can be removed at convenience	Should be removed at once to avoid damage to starter and ballast	Can be removed at convenience	Can be removed at convenience
Sensitivity to Voltage Variation	Should be operated within 2 per cent of rating for best results	No material difference throughout range marked on auxiliary. Beyond that, life is shortened	No material difference throughout range marked on auxiliary. Beyond that, life is shortened	No material difference throughout range marked on auxiliary, but arc extinguishes if voltage drop is more than 10 per cent below rating
Light Utilization Efficiency	High brightness source; should have white bowl or enclosing globe to reduce glare	Low brightness source; no light diffusing media required	Low brightness source; no light diffusing media required	High brightness source; must be placed well above eye level to avoid glare
Heat Radiation	10 per cent of total energy as light and 80 per cent as heat	20 per cent of total energy radiated as light and only 30 per cent as heat. Cool light for high-intensity illumination	20 per cent of total energy radiated as light and only 30 per cent as heat. Cool light for high-intensity illumination	20 per cent of total energy radiated as light and 40 per cent as heat

be great enough to be the deciding influence when the other cost factors are almost equal.

There are additional factors, quite aside from cost, that must be weighed before a decision is reached as to the type of lighting to be used. For example, mercury vapor lamps require 5 to 10 minutes to cool before they can be relighted after once having been in operation. Where there are frequent power failures or 10 per cent dips in the line voltage that cause the lamps to drop out of operation, the time interval before the arc re-establishes may be a paramount objection. Of course, to combine a certain amount of incandescent lighting with the mercury vapor lighting will serve both to correct the color and to bridge the gap following power failures, but the lighting cost would be increased in proportion to the amount of incandescent lighting used. Again, fluorescent lamps frequently blink "on" and "off" when they have failed, and should be removed promptly to avoid damage to the starter switch and the ballast unit. If the lamps must be installed in such a way that ready access is impossible, it may be necessary to adopt the slightly more expensive rectifying fluorescent lamps, which do not require prompt removal on failure.

The 85-watt rectifying fluorescent lamps have about three times the unit brightness of the 40-watt fluorescent lamps, and for comparable freedom from glare, should, therefore, be suspended higher above the working plane. This, however, means that they will be less accessible and more difficult to renew upon failure.

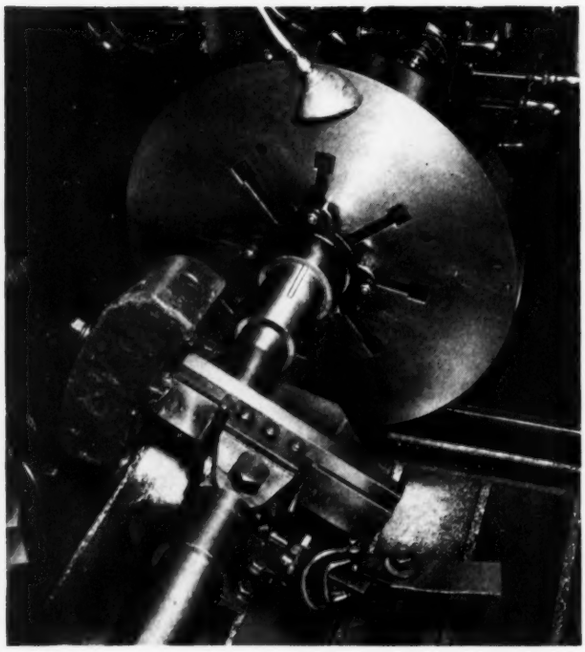


Fig. 1. Driving End of a Boring-bar Used in Taper-boring Rudders for Cruisers and Battleships

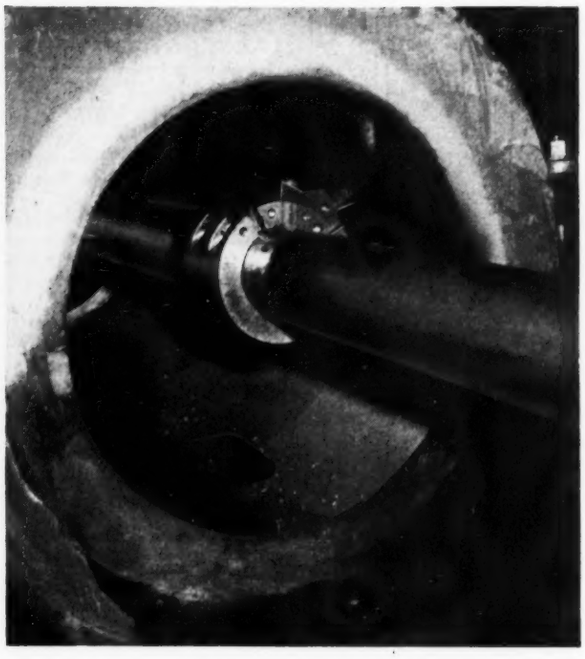


Fig. 2. View of the Boring Head Employed in Finishing the Tapered Hole in Ship Rudders

Boring the Large Tapered Hole in Ship Rudders

SPECIAL equipment has been devised at the Fore River Yard, Quincy, Mass., of the Bethlehem Steel Co., Shipbuilding Division, to facilitate boring the tapered hole in the rudders of cruisers and battleships on a floor type horizontal boring, drilling, and milling machine. Because of the nature of the cut, it is necessary to pivot one end of the boring-bar on the far side of the work from the faceplate of the machine, and to position the other end off center a sufficient amount to obtain the desired taper as the cutter is fed through the work. The front or off-center end of the boring-bar is shown in Fig. 1, from which it will be seen that coarse sidewise adjustment can be obtained by sliding the end of the bar along ways on a head attached to the spindle of the machine, after which it is held in position by plugs which are inserted in holes in the ways. This unit is provided with a counterweight to compensate for the eccentric rotation of the heavy boring-bar and the tool-head.

Fig. 3. Unusual Type of Steadyrest which Permits Eccentric Rotation of the Rudder Boring-bar

The view of the boring head in Fig. 2 shows that a single fly cutter is employed, the cut being taken through the bore by feeding the cutting head along the bar by a feed-screw which is operated by a star feed. In the operation illustrated, the bore of the rudder was approximately 5 feet long and the diameter about 24 inches.

Because of the length of the bore, the boring-bar must be supported on the opposite side of the work from the faceplate. This is accomplished by employing a steadyrest of the design illustrated in Fig. 3. The steadyrest consists of a housing, bolted to the bed of the boring

machine, within which a large ring revolves concentrically with the spindle of the boring machine. Within this rotating member there is a square block that is free to slide in relation to the center of the rotating ring, as required by the eccentric rotation of the boring-bar at the point where the steadyrest is located. In addition to this automatic sidewise adjustment, the bearing that holds the boring-bar in the steadyrest is free to tilt in any direction.

* * *

Automatic Spray Machines for Coating Shells Rapidly

Shells are being coated on the outside in sizes ranging from 20 to 105 millimeters at the rate of 1000 an hour in several large shell-loading plants of the United States Ordnance Department by the use of automatic spray-painting equipment built by the Binks Mfg. Co., Chicago, Ill. The finishing is entirely automatic, with the exception of loading and unloading the spindles. The shells are placed manually on the spindles, which are mounted on a long conveyor chain. Simple masking rings and plugs are used to protect threads from becoming coated during the finishing process.

The spindles with their loads first pass through a preheating oven, which removes all traces of moisture from the shells. The spindles then carry the shells directly into a water-wash spray booth. Here the spindles begin to revolve rapidly, and as each one comes in front of the automatic spray guns, the shell on it receives a fine, even coating. To avoid waste, the guns operate only when a loaded spindle is in front of them. The freshly coated shell is next carried into a drying oven, from which it emerges four minutes later, completely dried and ready for handling. In this way, a shell is coated and dried every 3.6 seconds.

The coating material is supplied to two or more automatic spray guns through a paint circulating system. Paint regulators, oil and water extractors, and a hose cleaner are conveniently mounted on the booth.

Automatic and semi-automatic machines for spraying the inside and outside of shells ranging from the 20-millimeter size up to 2000-pound bombs have also been developed by the company mentioned. These machines vary widely in the production rate obtainable, according to the requirements of each manufacturer.

* * *

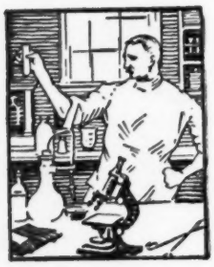
Brown & Sharpe Mfg. Co. Receives the Navy "E" Award

In recognition of outstanding accomplishments in the production of ordnance material vital to our national defense, the Brown & Sharpe Mfg. Co., Providence, R. I., has been presented by the Secretary of the Navy, Frank Knox, with the Navy "E" pennant and with the flag of the Bureau of Ordnance. On January 3, Henry D. Sharpe, president and treasurer, in the presence of company officials and department heads, accepted the pennant and flag on behalf of the firm and turned them over to Arthur H. Bainton, works manager.

Mr. Sharpe commented on the deep significance of the award and expressed his appreciation of the honor bestowed on the company and its employes. Mr. Bainton stated that still greater efforts will be made to continue to increase production. He felt certain that every employe would be proud of the fact that the firm had the privilege of flying the flag and pennant as an evidence of outstanding achievement. The employes will be entitled to wear a special lapel button bearing the company's name, the insignia of the Bureau of Ordnance, and the Navy "E." A brief ceremony to display the pennant and flag was held at the company's plant on January 5.

Automatic Paint-spraying Equipment that Turns out a Coated Shell Every 3.6 Seconds, Completely Dried and Ready for Handling

MATERIALS OF INDUSTRY



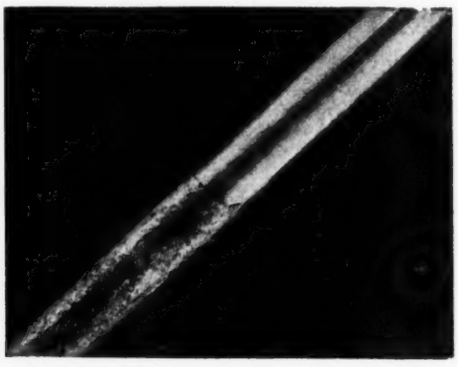
THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Nickel-Babbitt Metal Suitable for Heavy Bearing Loads

A new babbitt metal for bearings subject to high pressures and temperatures has been developed by the Magnolia Metal Co., 120 Bayway, Elizabeth, N. J. This metal, known as Power Nickel Genuine Babbitt, has a tensile strength of 17,500 pounds per square inch, a yield point of 6500 pounds per square inch, and a Brinell hardness of 27. Its pouring temperature ranges from 950 to 1000 degrees F. The high softening and melting temperatures make the metal resistant to extreme local heat. Because of its unusual strength, it is adapted for heavy bearing loads such as are encountered in railroad service, rolling mill machinery, and paper mill machinery. The nickel treatment gives the metal a hard glossy surface, desirable for generators, motors, and other high-speed applications. 201

Salt Water Corrosion had No Effect on This Shaft

The accompanying illustration, made from an unretouched photograph, shows a Monel propeller shaft, 7/8 inch in diameter and 80 inches long, which was recently brought to the surface by a fisherman off the Long Island coast. The shaft had evidently been in the water for years, because clay and slime had caked to a hard crust on it. The illustration shows how the shaft looked before and after this crust had been scraped and scrubbed off. Underneath the crust, the surface of the Monel metal shaft was still found to be smooth and glossy, and threads and keyways were as clean as the day they were machined. 202



When Clay and Slime were Removed from the Surface of This Monel Propeller Shaft, which had Been Submerged in Salt Water for Years, No Harmful Effects of Its Long Immersion were Visible

New Alloy Steel for Gears, Dies, High-Speed Shafts, etc.

A medium-carbon electric furnace steel of the chrome-nickel-molybdenum type is a new member of the Elastuf group of steels produced by Horace T. Potts Co., East Erie Ave. and D St., Philadelphia, Pa., and is designated Elastuf 44. This alloy steel is available in the heat-treated condition, and has a remarkably uniform cross-sectional hardness of approximately 44 Rockwell C. Its tensile strength is about 200,000 pounds per square inch, yield point 190,000 pounds per square inch, and elongation in 2 inches, 13 per cent in all sizes. It lends itself well to such operations as milling, drilling, shaping, planing, hobbing, tapping, threading, and turning, although high speeds, deep cuts, and heavy feeds are not practicable because of its hardness.

An important characteristic of this new steel is the smooth, high luster obtained after turning, threading, milling, or gear-cutting, the surfaces formed having a finish approximating that produced by grinding. This steel is finding applications in the manufacture of gears, worms, pinions, bull riveter dies, injection molding machine parts, compression dies and blocks, gudgeons, journals or short shafts—especially

To obtain additional information about materials described on this page, see lower part of page 160.

those upon which roller bearings run without an inner race—and high-speed shafts or axles subject to great torsional impact. It is available in rounds up to 8 inches in diameter, and special shapes and sizes of forgings can be obtained. It is not suitable for welding.....203

Nylon Used as Insulation in Electric Motors

The electrical-insulating efficiency of Nylon (manufactured by E. I. du Pont de Nemours & Co., Inc.) has made it possible to manufacture motors that occupy 10 to 15 per cent less space than motors of equivalent capacity using conventional magnet wire insulation. A corresponding saving in the iron cores is effected. Nylon coating, it is said, provides insulation resistant to abrasion and cracking, has good dielectric strength, and is not adversely affected by any of the conditions of moisture, temperature, or chemical action that such motors normally encounter.

This product is applicable to the types of motors used for small power tools, fans, vacuum sweepers, refrigerators, pumps, food mixers, voltage regulators, motor-generator sets, and other household and industrial appliances...204

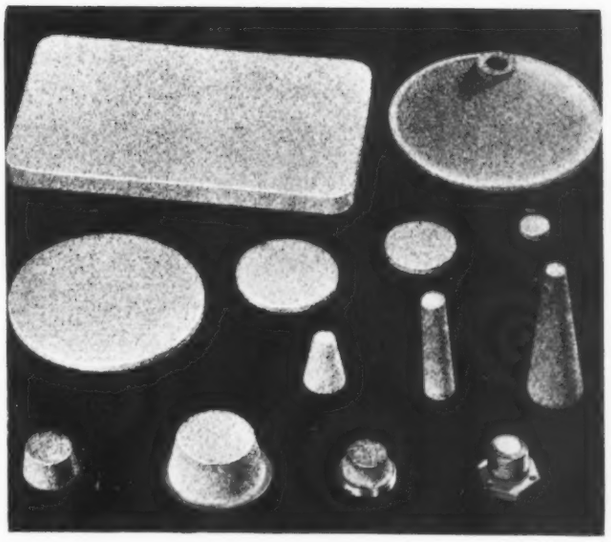
Powdered Metal Product Used for Filtration and Flow Control

A porous product known as "Porex," made of powdered metal, has recently been introduced by the Moraine Products Division of General Motors Corporation, Dayton, Ohio, for use in the control of filtration and flow of liquids and gases. It can be used to remove foreign materials from fluids, such as oil, and to alter the characteristics of gases by diffusion, reducing pressures and controlling flow rates.

One application is the prevention of clogging of orifices in Diesel injector nozzles. When so used, it removes fibrous materials not eliminated by other types of filters. This new filter also acts effectively in preventing the drying agent from passing from its chamber into a refrigeration system when the refrigerant passes through it to be dried.

In another of its many applications, "Porex" is used to protect the passages in oil-burner nozzle assemblies from being clogged by sludge, metal chips, dirt, and other foreign substances. It is also described as valuable for separating oil, moisture, and solids from the air supplied to paint spray equipment.

Its physical properties, such as structure, porosity, strength, and ductility can be varied



New Powdered Metal Filter is Available in Many Shapes for Use in Controlling Gas and Liquid Flow

within certain limits to suit specific applications, and similar variations are obtainable in its size and shape. This material is available in the form of disks, sheets, cylinders, and truncated cones, as well as in special shapes.

One important feature of "Porex" is that it can be bonded to steel and copper, and in this way made an integral part of solid metal, which can be machined, ground, bored, threaded, or otherwise processed to suit requirements...205

Compound that Protects Painted Surfaces against Dirt

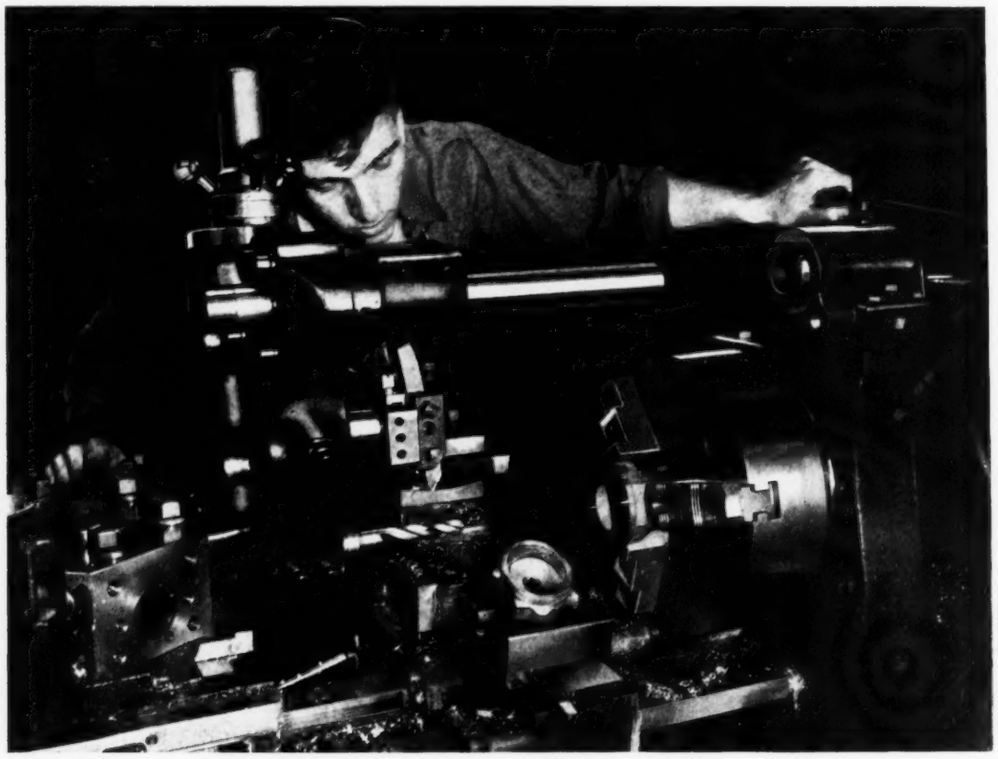
A washable protective covering for flat wall paint, designed for use in drafting-rooms, plants, warehouses, and offices, where it is desirable to provide for easy cleaning of painted walls, has been announced by the Bergonize Co., Merchandise Mart, Chicago, Ill.

The product can be applied over a newly painted or cleaned wall, and provides a clear, transparent, flat protective film which prevents dust, dirt, and grime from penetrating the pores of the paint. It has the advantage of being odorless. It dries flat within 20 minutes at 70 degrees F., and possesses high ability to reflect and diffuse light. One gallon covers approximately 1500 square feet.

The covering is removed from a protected surface merely by applying clear water with a sponge or rag, taking with it all dirt and leaving the surface in its original clean condition. It is not recommended for use in rooms where there is an extensive amount of steam in the air, or where condensation takes place on the walls or ceiling.....206

To obtain additional information about materials described on this page, see lower part of page 160.

Turret Lathe Operation in a Submarine Plant



Turret Lathe being Used for Machining Stuffing-box Nuts in a Typical Chucking Operation

A Warner & Swasey turret lathe tooled up for finishing stuffing-box nuts in the submarine-building plant of the Electric Boat Co., Groton, Conn., is shown in the accompanying illustration. The castings are first faced with a tool on the cross-slide, and then spot-drilled and turned by tools mounted on the turret face that is shown positioned toward the work. A tool on the next turret face is then employed for taking a boring cut in the cored hole, and this is followed by a light finishing cut on the bore, which is taken by a tool on the cross-slide block. Next, the casting is faced on the inside of the head end and under-cut at the back end of the bored surface by tools mounted on the cross-slide block.

Tools on the turret are then advanced to bevel the outside of the nut flange and to chamfer the outer end of the bore. A drill on the turret is next used to produce a small hole through the closed end of the nut, after which this hole is reamed by a tool on another turret face. In the final step in the operation, a solid tap on the turret cuts threads in the large bore.

Westinghouse Suggestion System

The number of accepted suggestions made by employes for improving the quality or speeding up the production of the Westinghouse Electric & Mfg. Co.'s products in 1941 was 22 per cent ahead of 1940. The company paid $15,998 in awards for accepted ideas, a 24 per cent increase over 1940. Since the suggestion system was introduced in 1910, more than 84,000 suggestions have been submitted by Westinghouse employes. For each suggestion accepted by the Committee of Supervisors, an award is made which bears a relation to the first year's net saving resulting from the suggestion. This year, Albert Bachofer, a 62-year-old machinist, was awarded $750 for a time-saving suggestion which made it possible to do a job 40 per cent faster than formerly. This was the largest award paid this year. Miss Mary Gallagher received fourteen checks in all, one for each of her suggestions which were accepted during 1941. One of her suggestions enabled the company to save a considerable amount of aluminum in the manufacture of a certain motor part.

Drilling, Reaming, and Tapping the Thousands of Holes in Condenser Tubesheets

Radial Drilling Machine Employed for Drilling, Reaming, and Tapping the 5000 or More Holes Required in Main Condenser Tubesheets for Naval Cruisers

MAIN condenser tubesheets for use aboard cruisers of the United States Navy have about five thousand holes in them, which must be drilled, reamed, and tapped to receive the ends of the condenser tubes. The accompanying illustration shows holes previously drilled in a tubesheet being reamed under a Cincinnati Bickford radial drilling machine in the shipyard of the New York Shipbuilding Corporation, Camden, N. J. The practice is to carefully lay out all the holes in one sheet, and after they have been drilled, to use that sheet as a jig for drilling two more sheets. No more than two sheets are ever drilled from one that is laid out, however, as experience has shown that serious errors are likely to occur when one sheet is used as a jig for the correct drilling of a greater number than two sheets.

The Seamless Steel Tube Institute Offers New Service to Tube Buyers

A new service whereby purchasers of tubing can obtain information on the availability of various grades and sizes of seamless steel tubing for new or special wartime requirements has been established by the Seamless Steel Tube Institute, Gulf Building, Pittsburgh, Pa.

This step, it is explained, was taken for the benefit of two classes of tube purchasers: First, those who have bought certain grades of tubing for use in peacetime products, but who may be unfamiliar with sources of supply for other or special grades of tubing required for war equipment; second, and perhaps more frequently encountered today, those manufacturers who never before used seamless steel tubing, but who now will manufacture products in which this material is required. They may not be familiar with the sources of supply, especially in the case of certain specialties which are not manufactured generally, and may be available only from two or three mills in the country.

NEW TRADE LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts and Materials. To Obtain Copies, Fill in on Form at Bottom of Page 159 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the February Number of MACHINERY

Temperature Control Systems

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa. Bulletin 36-4, containing technical data on Brown temperature control systems for fuel-fired galvanizing kettles. Bulletin 85-17, containing technical data on the Brown automatic program time-temperature control systems. 1

Arc-Welding Equipment

LINCOLN ELECTRIC CO., Cleveland, Ohio. Catalogue describing the Lincoln "Shield-Arc" welder with self-indicating dual continuous control. Application Sheet No. 78 in a series on Machine Design, describing the redesign for welded construction of the swinging knee for a press. 2

Flexible Lacquer and Enamel Finishes

ROXALIN FLEXIBLE LACQUER CO., Box 511, Elizabeth, N. J. Publication entitled "Facts About U. S. Government Finishes," containing data sheets giving Army and Navy specifications for finishes, and telling how and where they are applied. 3

Hydraulic Vises

STUDEBAKER MACHINE CO., 9 S. Clinton St., Chicago, Ill. Folder descriptive of the new Studebaker hydraulic "Visepress," suitable for ordinary vise operations and for press operations on small parts production where speed and accuracy are required. 4

Plexiglas

ROHM & HAAS CO., Washington Square, Philadelphia, Pa. Plexiglas Fabricating Manual prepared specifically for Army and Navy maintenance stations companies manufacturing military aircraft, and other firms fabricating Plexiglas for defense purposes. 5

Calendar for 1942

BROWN INSTRUMENT CO., Wayne and Roberts Aves., Philadelphia, Pa., is distributing a 1942 calendar (G-45) portraying the varied problems encountered in modern industrial processes by a series of cartoons by Bill Eddy. Photographs of Brown industrial instruments and control devices are also shown. 6

Electrode-Pressure Gage

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-3628, describing the construction, operation, and application of the G-E electrode-pressure gage, designed to measure the pressure between electrodes of resistance welding machines. 7

Universal Cutter Grinder

ROAN MFG. CO., 1220 Washington Ave., Racine, Wis. Bulletin describing the new Roan universal tool and cutter grinder, suitable for grinding and sharpening all types of metal-working tools, as well as for contour and surface grinding. 8

Meehanite Castings

MEEHANITE RESEARCH INSTITUTE, 311 Ross St., Pittsburgh, Pa. Handbook on Meehanite castings, describing their manufacture, metallurgy, and engineering properties. A copy is available to those writing on business letter-heads. 9

Die Springs

MUEHLHAUSEN SPRING CORPORATION, Logansport, Ind. Bulletin illustrating and describing die springs for high-speed presses, regular-speed presses—hand tools, jigs, etc.—and heavy-duty presses. Prices are included. 10

Precision Surface Grinders

TAFT-PEIRCE MFG. CO., Woonsocket, R. I. Catalogue describing the special features of design of the Taft-Peirce No. 1 precision surface grinder, especially adapted for grinding small parts, gages, and tools. 11

Aluminum-Bronze Alloys

AMPCO METAL, INC., 1745 S. 38th St., Milwaukee, Wis. Pamphlet descriptive of the use of Ampco metal in bearings and bushings. Bulletin describing the application of Ampco metal in centrifugal castings. 12

Stainless-Clad Steel

JESSOP STEEL CO., Washington, Pa. Price list containing base prices for the twelve grades of Silver-Ply stainless-clad steel plates and sheets, as well as prices on machining the stainless-clad steel plates. 13

Pressed-Steel Trucks and Wheels

AMERICAN PULLEY CO., Philadelphia, Pa. Catalogue T-41, covering this company's line of pressed-steel hand trucks and wheels, as well as other material-handling equipment. 14

Industrial Dust Collectors

LEIMAN BROS., INC., 156 Christie St., Newark, N. J. Circular showing typical examples of Leiman dust collectors for use with grinding machines, saws, sand wheels, etc.; rotary air pumps; and sand-blast machines. 15

Use and Care of Blow-Torches

CLAYTON & LAMBERT MFG. CO., Detroit, Mich. Booklet entitled "Torch Pointers," containing information on the operation and care of blow-torches, designed for use by trade school students and apprentices. 16

Diamond Wheel-Dressing Tools

DIA-TOOL, INC., 320 Yonkers Ave., Yonkers, N. Y. Bulletin describing diamond wheel-dressing tools, in which the diamonds are mounted in a tungsten-carbide matrix. Operating instructions on the use of these tools are included. 17

Variable-Speed Control Units

REEVES PULLEY CO. OF NEW YORK, INC., 76 Dey St., New York City. Circular describing the service offered by the company in solving variable-speed problems, and showing typical examples of variable-speed control units. 18

Abrasive Cutting Machine

ANDREW C. CAMPBELL DIVISION OF AMERICAN CHAIN & CABLE CO., INC., Bridgeport, Conn. Circular illustrating and describing the new No. 425 Campbell Cutalator—an oscillating type abrasive cutting machine. 19

Heavy-Duty Electric Hoists

CHISHOLM-MOORE HOIST CORPORATION, 120 Fremont Ave., Tonawanda, N. Y. Bulletin 142, illustrating and describing CM Meteor heavy-duty electric hoists, designed to speed industrial production. 20

Precision Engineering

MERZ ENGINEERING CO., 200 S. Harding St., Indianapolis, Ind. Bulletin entitled "Where Precision Transcends Every Other Consideration," showing operations in the production of extremely accurate gages, instruments, and machine tools. 21

High-Speed Precision Milling Machines

JEFFERSON MACHINE TOOL CO., Fourth, Cutter, and Sweeney Sts., Cincinnati, Ohio. Circular illustrating and describing the Jefferson motor-driven "Bull Dog" high-speed precision milling machine, built in floor and bench types. 22

Arc-Welding Machines

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-3726, descriptive of the new General Electric "Strikeasy" arc-welder, especially developed for the rapid fabrication of aircraft tubing and all thin-gage metals. 23

Zinc

NEW JERSEY ZINC CO., 160 Front St., New York City. Folder entitled "Zinc in War," published to keep American industrial men informed about one of the vital war materials used for many purposes in the armament program. 24

Oil-Retaining Bearings

BOUND BROOK OIL-LESS BEARING CO., Bound Brook, N. J. Die List No. 18, of "Compo" oil-retaining porous bronze bearings, listing a wide range of sizes in sleeve type and flanged bearings and thrust washers. 25

Resistance-Welder Switch

WESTINGHOUSE ELECTRIC & MFG. CO., East Pittsburgh, Pa. Booklet B-3025, describing a power switch known as the Weld-O-Trol, designed to speed up production in resistance welding. 26

Hand-Pumps

WATSON-STILLMAN CO., Roselle, N. J. Bulletin 240-A, describing hand-operated, high-pressure pumps for testing purposes and for operating hydraulic jacks and other small hydraulic tools. 27

Hex Socket Screws

BRISTOL CO., Waterbury, Conn. Folder 845, describing the Bristol line of Hex socket screws, including set-screws, cap-screws, socket-head stripper bolts, pipe plugs, etc. 28

Electric Motors

WAGNER ELECTRIC CORPORATION, 6467 Plymouth Ave., St. Louis, Mo. Bulletin MU-183, descriptive of Wagner single-phase, direct-current, and small polyphase motors. 29

Electric Furnaces

GENERAL ELECTRIC CO., Schenectady, N. Y. Circular GEA-3596, describing the construction and operation of the new G-E box type

To Obtain Copies of New Trade Literature

listed on pages 158-160 (without charge or obligation), fill in below the publications wanted, using the identifying number at the end of each descriptive paragraph; detach and mail to:

MACHINERY, 148 Lafayette St., New York, N. Y.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Name ..... *Position or Title* .....

[This service is for those in charge of shop and engineering work in manufacturing plants.]

Firm .....

Business Address .....

City ..... *State* .....

[SEE OTHER SIDE]

tool-room electric furnaces for heat-treating steel without decarburization. 30

Parts for Universal Motors

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Booklet B-3004, descriptive of parts for built-in universal motors used in drills, screwdrivers, shapers, and other applications. 31

Portable Electric Tools

SKILSAW, INC., 5033 Elston Ave., Chicago, Ill. General catalogue No. 43, entitled "Tools for Defense of America," covering the Skilsaw line of portable electric tools..... 32

Production Tools

PRODUCTS ENGINEERING CO., 700 E. Florence Ave., Los Angeles, Calif. Catalogue on Peco products, including quick-acting clamps, rivet sets, "Speedrivers," and drill bushings. 33

Industrial Vacuum Cleaners

IDEAL COMMUTATOR DRESSER CO., 1274 Park Ave., Sycamore, Ill. Leaflet illustrating and describing Ideal 3-in-1 portable vacuum cleaners for industrial use..... 34

Portable Electric Tools

INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, Ill. Catalogue 37, covering the Thor line of portable electric tools. 35

Thread Gages

AXELSON MFG. CO., 6160 S. Boyle Ave., Los Angeles, Calif. Folder describing Axelson thread plug and ring gages, and showing typical applications. 36

Electric Furnace Brazing

WESTINGHOUSE ELECTRIC & MFG. Co., East Pittsburgh, Pa. Booklet B-3019 describing how to cut production costs of metal parts with electric furnace brazing. 37

Lock-Nuts

PALNUT CO., 61 Cordier St., Irvington, N. J. Bulletin describing the principle of design and application of Palnut lock-nuts, which have a double locking action..... 38

Air-Pressure Valves

HANNIFIN MFG. CO., 621-631 S. Kolmar Ave., Chicago, Ill. Bulletin 56, illustrating and describing the Hannifin air-pressure regulating valve. 39

New Film Depicts Story of Aluminum

One of the most fascinating industrial motion pictures ever produced has just been completed by the Wilding Picture Productions, Inc., for the Aluminum Co. of America. The new picture, produced in technicolor, is called "Unfinished Rainbows." Most of the picture, except the industrial plant scenes, was made in Hollywood with Hollywood actors. In a sense, it is a biography of the aluminum industry from the time the metal was discovered up to the present. The historical scenes and incidents are thoroughly documented.

In addition to presenting the highlights of the story of the discovery and application of aluminum, the manner in which the film is presented makes it especially stimulating to the younger generation of engineers and scientists. It shows how in the past many young men have been inclined to believe that they were "born too late"—that by the time they had finished their education, practically everything had been invented and developed, and that there was comparatively little ahead for the trained young man to do. "Unfinished Rainbows" suggests that this world is still unfinished—that there is still an endless array of things for the inquiring mind to discover.

The picture will be made available in both 16- and 35-millimeter films to high schools, colleges, and other educational institutions, engineering and industrial associations, and other interested groups. Applications should be made to the Aluminum Co. of America, Gulf Bldg., Pittsburgh, Pa.

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 161-178 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in February, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

To Obtain Additional Information on Materials of Industry

To obtain additional information about any of the materials described on pages 154-155, fill in below the identifying number found at the end of each description — or write directly to the manufacturer, mentioning name of material as described in February, 1942, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.

Fill in your name and address on other side of this blank.

Detach and mail to MACHINERY, 148 Lafayette St., New York, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

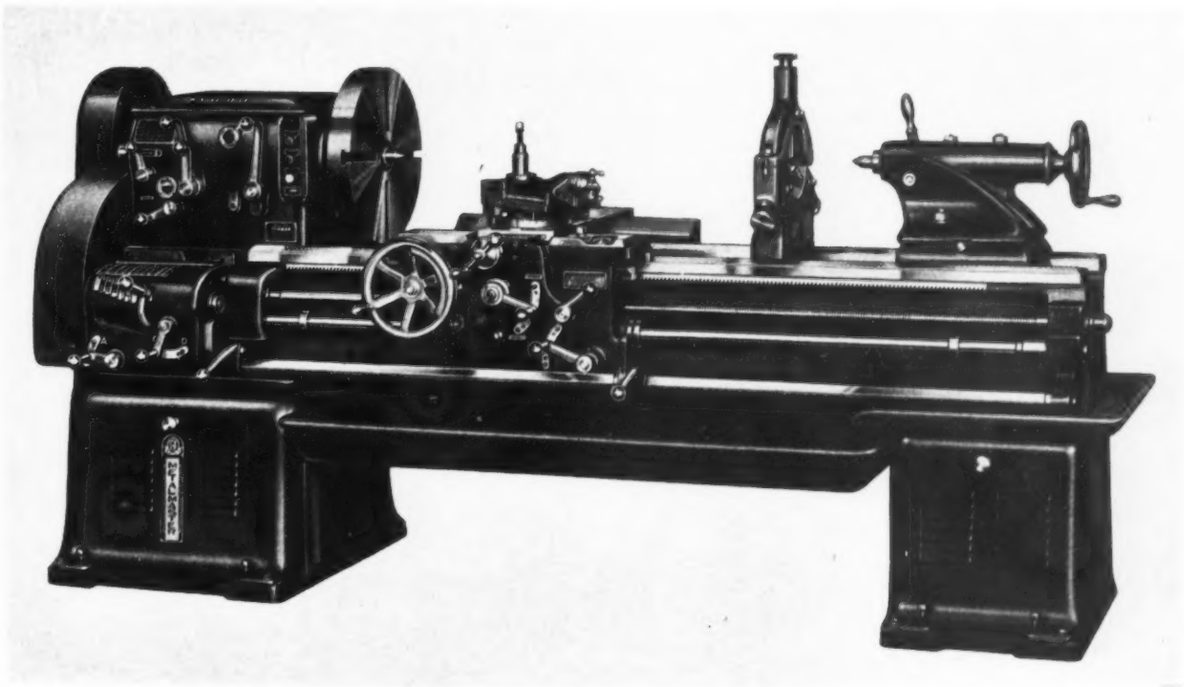
Bradford Metalmaster Geared-Head Lathe

A new geared-head lathe known as the "Metalmaster" is being manufactured by the Bradford Machine Tool Co., 657-671 Evans St., Cincinnati, Ohio, in 12-, 14-, and 16-inch sizes. A feature of this machine is the rugged headstock, with heavy walls and a sturdy center bracing rib that supports all the short intermediate gear shafts in tapered roller bearings. The spindle is mounted in heavy-duty precision taper roller bearings that are preloaded and easily adjustable. All gears are nickel alloy steel, heat-treated, shaved, and lapped to close tolerances for smooth and quiet operation. All sliding gears are mounted on cylindrically ground splined shafts with integral cut splines.

Twelve spindle speeds ranging from 16 to 400 R.P.M. are available in both forward and reverse directions. These speeds, in geometrical ratio, are obtained by shifting gears through levers at the front of the head, a direct reading index-plate being provided to indicate the lever positions for all speeds.

In addition to the speed-change gears in the head, there are gear trains for the lead-screw reverse and the fine and coarse compounding drive to the feed-box. All gears are splash-lubricated. A pump forces filtered oil to all the bearings and to the clutch and brake, which are housed in a separate casting. Seals on the spindle and all shafts prevent oil leakage. The spindle is a high-carbon molybdenum steel forging, with the center hole bored from the solid. All machining and testing operations on the spindle have been especially developed to insure accurate running balance and prevent distortion or chatter.

The headstock is driven by a constant-speed motor mounted on an adjustable hinged plate in the ventilated leg, where it is easily accessible for oiling and inspection. The drive is through multiple V-belts and an oil-immersed disk clutch. The clutch can be easily operated by a handle at the front of the bed near the head, as well as by a second handle at the right of the apron. The multiple disk brake is also operated by the same



"Metalmaster" Geared-head Lathe, Built by the Bradford Machine Tool Co.

To obtain additional information on equipment described on this page, see lower part of page 160.

handles, thus facilitating "jogging." Both clutch and brake are easily adjusted. Starting, reversing, and stopping are effected by electrical control through push-buttons.

The lead-screw is used for thread-cutting only, and can be disconnected from the quick-change gearing when not in use. Adjustable stop-collars on the feed-rod can be set to stop the carriage for turning or thread-cutting in either direction. Positive jaw clutches controlled by one lever are used to engage length and cross feeds, thus preventing the accidental engagement of the two feeds at one time. A chasing dial, built into the carriage, is conveniently located for use in cutting threads. Large graduated dials are provided on both cross-slide and compound rest feed-screws.

The long, heavy tailstock of the offset type is designed to insure accurate alignment, and can be set over for taper turning. Spring collets of 7/8-inch maximum capacity, opened and closed by a handwheel on the outer end of the draw-rod, are available for round, square, or hexagonal bars of standard size. A spindle nose type attachment can be used for work that is over 7/8 inch in diameter.

A micrometer positioning stop provides a positive stop for turning parts to uniform length. A thread-chasing stop is provided for threading work on a production basis. This stop can also be used for repetitive turning, boring, and internal or external chasing operations. The lead-screw reverse, operated from the left side of the apron, makes it possible to reverse the direction of the carriage travel under power when chasing or feeding without changing the direction of rotation of the headstock spindle. The use of single-tooth clutches insures correct register between the spindle and the lead-screw.

The 12-inch lathe is made in five bed lengths ranging from 6 to 14 feet, while the 14- and 16-inch lathes are made in six lengths from 6 to 16 feet. The actual swing over the beds of the three sizes of lathes is 14 1/2, 16 1/2, and 18 1/2 inches, and over the carriage bridge 9 3/8, 11 5/8, and 14 1/4 inches. The diameter of the hole through the spindle in all three sizes is 1 3/8 inches. The 12- and 14-inch lathes have a thread-cutting range from 1 1/2 to 368 threads per inch. The range of the 16-inch lathe is from 1 to 224 threads per inch. The range of feeds is from 0.00072 to 0.1780 inch per revolution of the spindle for the two smaller lathes, and from 0.0011 to 0.2670 inch for the large lathe. The three sizes of lathes weigh 3000, 3200, and 4000 pounds. 51

Simmons Horizontal Boring Machine

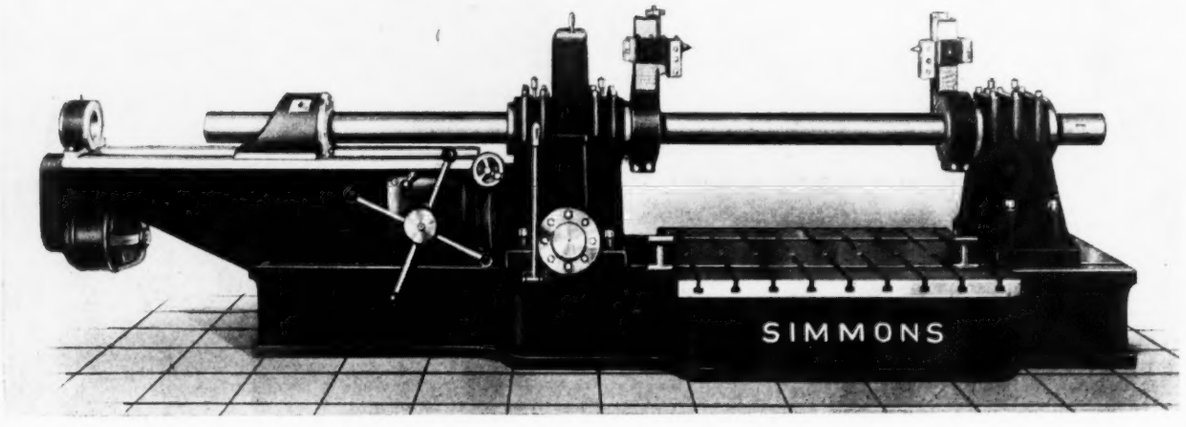
A horizontal cylinder boring machine with a 6-inch boring-bar has been brought out by the Simmons Machine Tool Corporation, 1600 N. Broadway, Albany, N. Y. The bed of the machine is 15 feet 8 1/2 inches long, with a widened portion 4 feet 4 1/2 inches by 5 feet 8 inches long and 1 1/2 feet high, having both horizontal and cross T-slots. The height from the top of the bed to the center line of the boring-bar is 2 feet.

The headstock encloses the worm-gearing, which comprises the main drive to the boring-bar. This gearing runs in an oil bath within the housing. The headstock and tailstock provide a double bearing for the driving quills. The tailstock has an adjustment range of 5 feet along the bed.

The extension is of box type construction and has accurately machined double ways for the carriage feed head and for supporting the boring-bar in the withdrawn position. The feed-box mechanism is housed in this extension. The 6-inch boring-bar, of turned and ground high-carbon steel, is normalized and has a Brinell hardness of 190 to 220. It is 17 feet long and provided with multiple splines for its entire length.

The feeds are obtained through the Simmons Micro-Feed unit, which is a stepless variable-speed transmission built integral with the extension and with separate rapid traverse motor. This unit provides both fine and coarse feeds ranging from 0.004 to 1 inch per revolution of the spindle. The bar has a travel capacity of 60 inches in one setting. Quick return of the bar is accomplished by a conveniently located control. This drive is also used for keyseating and light planing operations.

The capacity between the facing heads is 60 inches on a machine equipped with a 17-foot bar. The machine can be furnished with bars



Horizontal Boring Machine Brought out by the Simmons Machine Tool Corporation

To obtain additional information on equipment described on this page, see lower part of page 160.

up to 24 feet in length. Facing operations can be performed on work from 9 to 38 1/2 inches in diameter. The main drive to the boring-bar is obtained through a six-speed gear-box with hardened high-carbon steel gears on spline shafts, with anti-friction bearings running in oil. The machine is arranged for mounting a 15-H.P. motor on the gear-box with provisions for a V-belt drive. The bar speeds with a variable-speed motor are 1 to 16 R.P.M., and with a constant-speed motor 3 to 12 R.P.M. The weight is 16,000 pounds. 52

Wickman High-Speed Precision Automatic

A new Swiss type automatic machine, known as the Wickman high-speed precision automatic, has just been placed on the market by the Wickman Corporation, 15533 Woodrow Wilson Ave., Detroit, Mich. This machine is being manufactured by the Sheffield Corporation, Dayton, Ohio, but is sold, tooled, and serviced by the Wickman organization. It is designed for use on a wide variety of work, being particularly adapted for the production of pinions, shafts, and long slender parts such as are used in the manufacture of clocks, meters, and precision instruments for aircraft and radio sets. In the armament field, it is especially suitable for producing striker pins, detonators, and pinions for fuses.

The outstanding features of the machine are the sliding headstock and the tool-head, which carries five radially operated tools. The tools and cam are designed as simply as possible to facilitate setting-up operations. Single-point turning tools are used, and all tools are provided with micrometer adjustment in both directions.

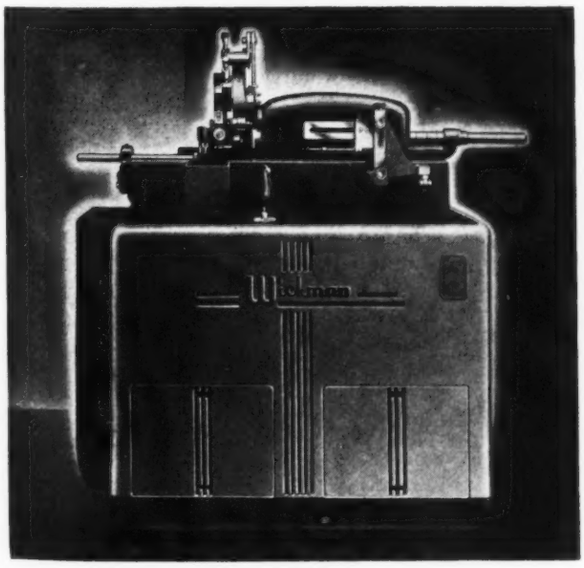
Finish, accuracy, and concentricity of the work are maintained by a guide bushing in the tool-head. This bushing revolves on a separate bearing, keeping a constant grip on the bar. The bushing can be locked in a stationary position so that it becomes a slip guide for the bar when desired. On jobs requiring no supporting guide, the bushing assembly can be removed to permit the spindle nose to travel right up to the tools.

The work is fed through the tools by the headstock. All movements of the headstock and tools are controlled by cams. By employing a combination of headstock and tool movements, any angle or form can be produced without the use of form tools. With this type of machine, there are almost no limitations to the scope of the back shoulder work which can be done. Many parts, even those having a pivot point, can be finished in cutting off, thereby eliminating second operations.

Among the more important features of construction are the spindle drive by endless flat belt, which when necessary, can be replaced in a few minutes; the headstock drive pulley, which is carried on an independent ball bearing; the spindle, which is not subjected to belt pull; and the tool-head with five tool-slides. An accelerating mechanism, built in the gear-box, speeds up the camshaft during the non-cutting periods. Other features are the chain drive to the camshaft which has geared feed changes; safety devices designed to protect the camshaft from overloads and the belt from breakage; wide range of spindle speeds; and ample chip and coolant capacity. 53

Hammond Carbide-Tool Grinder

A new carbide-tool grinder, known as the Hammond 14, designed for fast, accurate work, has just been brought out by Hammond Machinery Builders, Inc., 1619 Douglas Ave., Kalamazoo, Mich. It is available for either wet or dry grinding, and is built in two models, with cup-wheels on both sides or a cup-wheel on one side and a straight wheel on the other. The tables are mechanically controlled. Angular setting of each table is obtained by a handwheel, graduated in degrees. One revolution of the handwheel is equivalent to 30 degrees. The angular range is from 15 to 30 degrees below the



Wickman Swiss Type Precision Automatic

Hammond Carbide-tool Grinder

To obtain additional information on equipment described on this page, see lower part of page 160.

horizontal. A crank-handle serves to move the table toward or away from the wheel.

The table surface is grooved to facilitate tool movement and help keep it clean. A steel, replaceable wearing strip is inserted in the table next to the wheel. The table is 22 inches long by 12 inches deep. The machine itself is 56 inches wide, 50 inches high, and 32 inches deep. The pump for the coolant used in wet grinding is driven by a 1/4-H.P. motor. The machine is driven by a 3-H.P. reversing motor through multi V-belts. The spindle speed is 1350 R.P.M., providing a wheel speed of 5000 surface feet per minute. 54

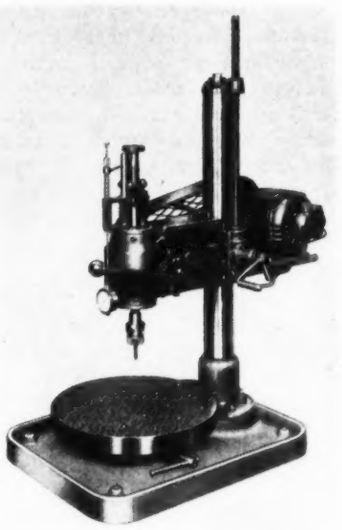
Diebel Automatic "Hi-Speed" Press

The Diebel Die & Mfg. Co., 3654 Lincoln Ave., Chicago, Ill., has developed an automatic press known as the "Hi-Speed" for use in the economical production of small stampings. The 4-inch ground cylindrical ram of this press provides a maximum bearing surface of more than 50 square inches. It runs in an adjustable bronze bearing sleeve designed to assure accurate alignment of the die. It is claimed that this arrangement increases the number of blanks produced between grinds from 10 to 30 per cent.

The feeding mechanism is of precision design, with all moving parts hardened and ground. The press feed is designed to positively and accurately feed work at all speeds, and to permit engagement or disengagement without stopping the press. With this press, strip stock can be handled almost as easily as coiled stock. Adjustment of the clamping tension on the feed rollers is not necessary. The press is provided with stock guides.

A maximum speed of 500 strokes per minute, with all parts operating smoothly and accurately synchronized, can be obtained. This permits the use of single dies where multiple dies were formerly necessary to meet production requirements. The ram has a stroke of 3/4 inch. The feed takes stock up to 4 1/2 inches wide, and can be adjusted for any feed up to 6 inches. The maximum die size is 6 1/4 by 8 inches, and the maximum die space, with the die closed, is 4 1/8 inches. Speeds of 180, 370, and 500 strokes per minute are available.

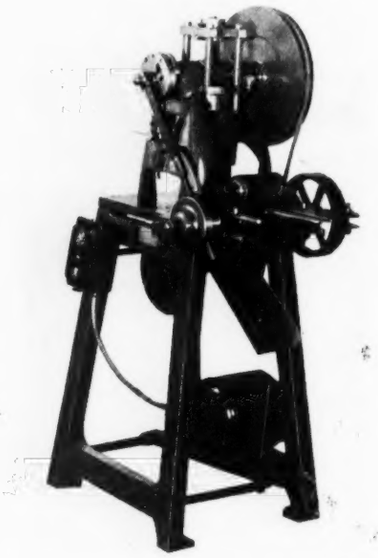
The 3/4-H.P. motor has a speed of 1725 R.P.M. and operates on 220-volt, 60-cycle, three-phase current. The motor has an overload protection starter switch. The machine requires a floor space of 20 by 32 inches; has an over-all height of 54 inches; weighs 500 pounds; and has an approximate rating of 4.4 tons. 55



Pacific Precision Tapping Machine

automatically thrown into the neutral position.

A dial indicator is provided for use in bottom-tapping. Four speeds are readily available. Simplicity of design and speedy operation are claimed to be outstanding features. Precision ball bearings are used throughout, and the machine is equipped with one lead-screw and lead-nuts to suit the customer's requirements. 56



Automatic Press Made by the Diebel Die & Mfg. Co.

Pacific Precision Tapping Machine

A precision tapping machine designed for tapping holes of any size up to 3/8 inch in diameter, including threads for 1/8-inch pipe —to meet army, navy, aeronautical, radio, and other government specifications — has been brought out by the Pacific Tool & Supply Co., 346 N. Vermont Ave., Los Angeles, Calif. This machine is also adapted for any type of manufacturing where No. 3 and No. 4 class specifications are demanded.

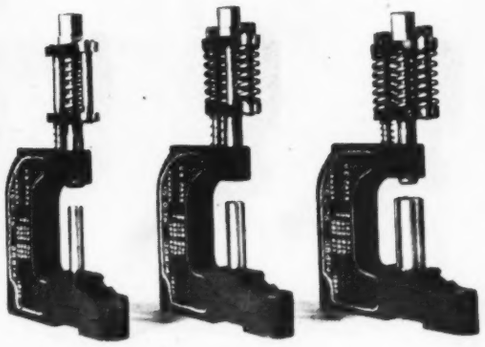
The spindle is full-floating, and the tap is guided by precision lead-screws, which can be easily and quickly changed. Lead-screws can be furnished for any screw pitch, right- or left-hand threads. The tapping handle can be set at any convenient position. When the handle is released, the spindle is

Selective Strippers for Hole-Punching Dies

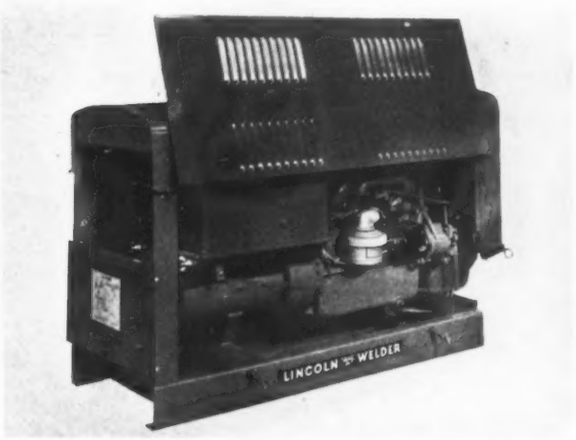
Selective strippers for Wales hole-punching dies are one of the latest developments in the line of punching equipment brought out by the Strippit Corporation, 1200 Niagara St., Buffalo, N. Y. These patented strippers, with three instantly removable and interchangeable springs, provide a tension choice of one-, two- or three-spring actuated pressure strippers, designed to provide the exact stripping action required by various gages and types of metal. Any metal that can be punched can be stripped from the punch with the tension provided by the three springs.

Wales dies are self-contained units requiring no attachments to the ram of the press. Each individual unit can be reset or removed from the rail quickly. Free-floating punches can also be lifted out of their guides. Even the punches,

To obtain additional information on equipment described on this page, see lower part of page 160.



Selective Strippers for Wales Hole-punching Die



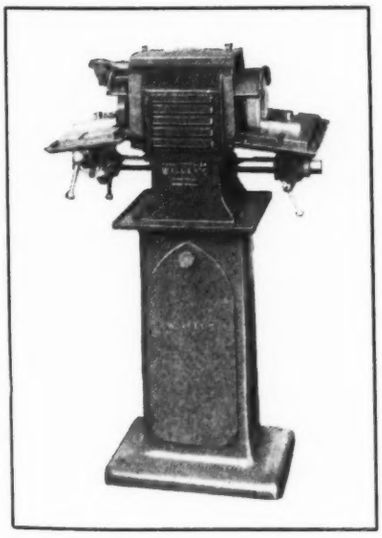
Lincoln 200-ampere Engine-driven Arc-welder

guides, and springs can be quickly removed from the holders. The new selective stripper provides effective stripping control, besides making it possible to punch 5/16-inch holes on 3/4-inch centers. These hole-punching dies are available in a wide range of standard and special sizes, capacities, and models. 57

Double-End Carbide-Tool Grinder

A Model 24 grinder, designed for efficient free-hand grinding of tungsten-carbide tipped tools, as well as other types of tool bits, has been brought out by the Willey's Carbide Tool Co., 1342 W. Vernor Highway, Detroit, Mich. The fully enclosed ball-bearing motor of this grinder is of special design and can be furnished for 220- or 440-volt, 60-cycle, three-phase current to operate at a speed of 3450 R.P.M. It is controlled by a drum type reversible switch. The motor shaft is tapered at both ends to insure positive wheel alignment. Bearings are adjusted by means of a thrust collar on one end of the motor shaft. The diamond wheel is lubricated by gravity from a large conveniently located reservoir.

The tool-rest table has an angular adjustment range of 30 degrees. The table is also adjustable, with quick-clamping features, to compensate for wheel wear. The height of the spindle above the floor is 43 inches, the floor space required 40 by 18 inches, and the size of the tool-rest table 16 by 7 inches. The diamond-holder is 3/8 by 1 1/2 inches, and the wheel size with steel back is 8 by 1 1/4 by 1 1/4 inches, with a 2-inch rim. A diamond wheel 6 inches in diameter by 3/4 by 1 1/4 inches, with a 3/4-inch rim, can also be used. The speed with an 8-inch wheel is approximately 7000 surface feet per minute. 58



Willey's Improved Double-end Carbide-tool Grinder

Sheffield Piston Gage

The Sheffield Corporation, Dayton, Ohio, has developed a new "Multichek," of the signal light indicating type previously described in MACHINERY, for checking simultaneously ten dimensions of an aircraft engine piston. This gage, designed to speed up piston inspection and at the same time reduce inspection cost, has ten gaging heads, three of which are in the back of the gage. 59

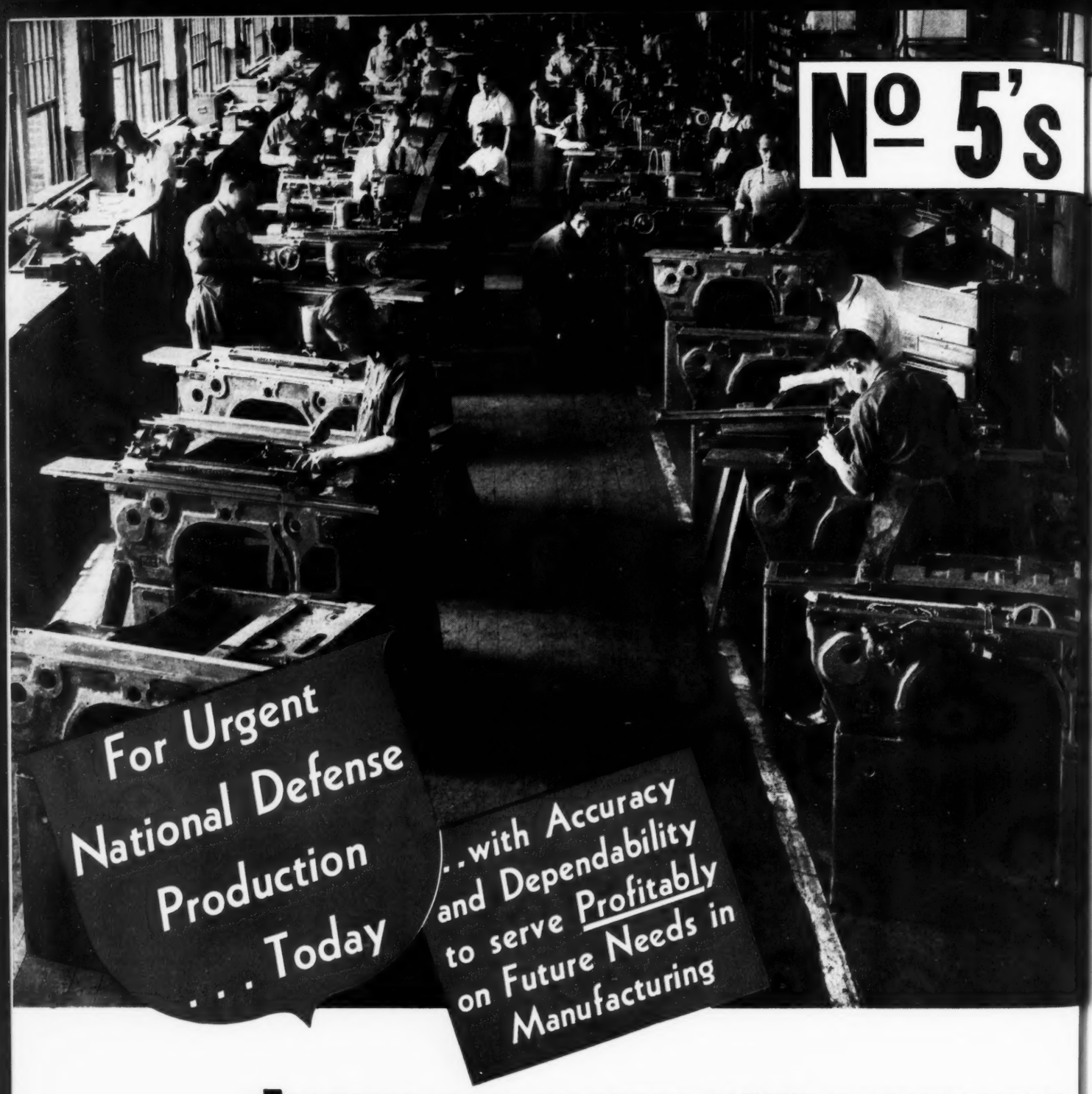
Lincoln Engine-Driven Arc-Welder

A new engine-driven, 200-ampere arc-welder, designed especially for job welding and garage work, which embodies a new system of engine speed control for maximum fuel economy and minimum engine wear, has been brought out by the Lincoln Electric Co., 12818 Coit Road, Cleveland, Ohio. This unit is designed for welding applications of all kinds and sizes. With a current range of 40 to 250 amperes, the machine can be used for the welding of light-gage metal, for the repair of cast-iron parts such as engine blocks, for the fabrication of machine parts and structures of many kinds, and for the hard-facing of worn parts.

Of direct-current type, it can be used to weld practically all metals and alloys with bare or shielded-arc type electrodes or with the carbon arc, when desirable. Its compactness and light weight make it portable, and hence suitable for work in remote locations. The self-indicating voltage control or job selector and current control facilitate the selection of any type of arc and any arc intensity to suit the job. The job selector is located on the right-hand side of the control panel, and the dial is graduated to show the available open-circuit voltage setting.

The welder is driven by a Hercules engine which is equipped with a centrifugal type governor, high-tension magneto with impulse starter coupling, and an oil bath air cleaner. The weight of the stationary model welder is 890 pounds. 60

To obtain additional information on equipment described on this page, see lower part of page 160.



FEATURES THAT WARRANT *YOUR* INVESTIGATION

Accurate sizing to .0001" on work diameter — unusually close-fitting spindle — automatic starting and stopping of headstock and coolant pump, controlled by cross feed handwheel — built-in electrical controls — recessed base — and many more.

May we send you specifications giving complete details?
Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

BROWN &

-in increasing volume for new production lines

--to give greater plant capacity for accurate grinding of small defense parts

Designed and built for just this type of work, No. 5 Plain Grinding Machines are serving in batteries in ever-growing defense industries where high production and very close limits are imperative.

B·S

SHARPE

Snyder Radius Contour-Milling Machine

A semi-automatic milling machine designed especially for radius contour-milling the bolt bosses on connecting-rod caps has been brought out by the Snyder Tool & Engineering Co., 3400 E. Lafayette St., Detroit, Mich. This new machine has three spindles and three revolving fixtures for machining three parts simultaneously. The spindles are of the quill type, ball-bearing mounted and driven by V-belts through spur gears running in oil. The spindles have quill clamps and vertical adjustment to compensate for tool wear. Coolant is supplied by a pump from a tank in the machine base. The fixtures are mounted on a main slide and are revolved by a cross-slide, both slides being hydraulically operated. The machine is electrically controlled by push-buttons.

The three parts are loaded on locating pins in drilled and reamed holes, and clamped manually. The machine cycle is automatic; as soon as the spindles start rotating, the main slide moves forward to the cutters and then feeds until the full depth of cut is reached. The cross-slide then revolves the fixtures in a half circle on the center line of the bolt-holes to mill the radius contour around the bolt bosses.

When the cut is completed, the main slide returns to the starting position and the cross-slide revolves the fixtures back to their loading position. Then the operator reverses the parts in the fixtures and the machine repeats its cycle, milling the other boss on each part. 61

Ny-Lint Gap-Gage Grinder

The Ny-Lint Tool Co., 1823 Sixteenth Ave., Rockford, Ill., is introducing on the market a gap-gage grinding machine that is especially designed for use in toolrooms. In addition to its use in grinding gap and snap gages, it can be employed for a variety of other grinding jobs. It has been designed to enable an inexperienced man to do accurate gage grinding after only a few hours' training.

The double-end, chrome-nickel steel spindle is mounted on precision preloaded ball bearings and driven by a pulley which is carefully balanced to eliminate vibration. The table is ground to a tolerance of 0.0001 inch, and mounted on a cross-slide with precision alignment. Longitudinal adjustment of the table is obtained with an accurate, hardened and ground, precision screw operating in a bronze nut and fitted with a micrometer dial reading to 0.0001 inch. The cross-slide is mounted on precision scraped V-ways.

Movement of the cross-slide toward the wheel is obtained by a lever fitted with a pinion that engages a rack on the bottom slide. This arrangement permits a quick and smooth movement of the work across the wheel. All ways are protected by covers extending beyond the travel limits. The spindle bearings are sealed to protect them from abrasive dust. A door at the front gives access to a tool compartment. The motor is mounted inside the bed at the rear, and drives the spindle through a double V-belt. Special wheels are employed for lapping work. 62

Enclosed Fan-Cooled Motor

A totally enclosed, fan-cooled motor (Type EA) in sizes ranging from 1 to 15 H.P. has just been brought out by the Torq Electric Mfg. Co., 6604 Carnegie Ave., Cleveland, Ohio. This motor represents a further step in the develop-

Radius Contour-milling Machine Brought out by the Snyder Tool & Engineering Co.

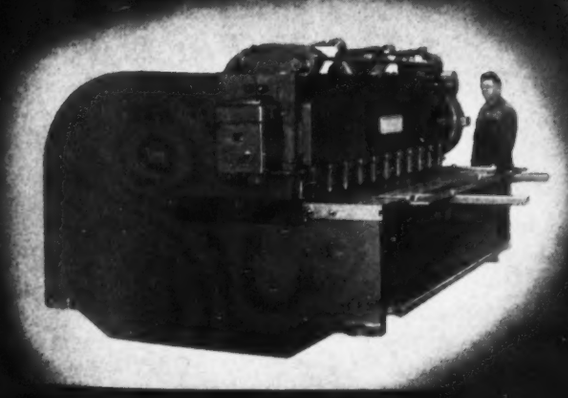
Gap-gage Grinder Manufactured by the Ny-Lint Tool Co.

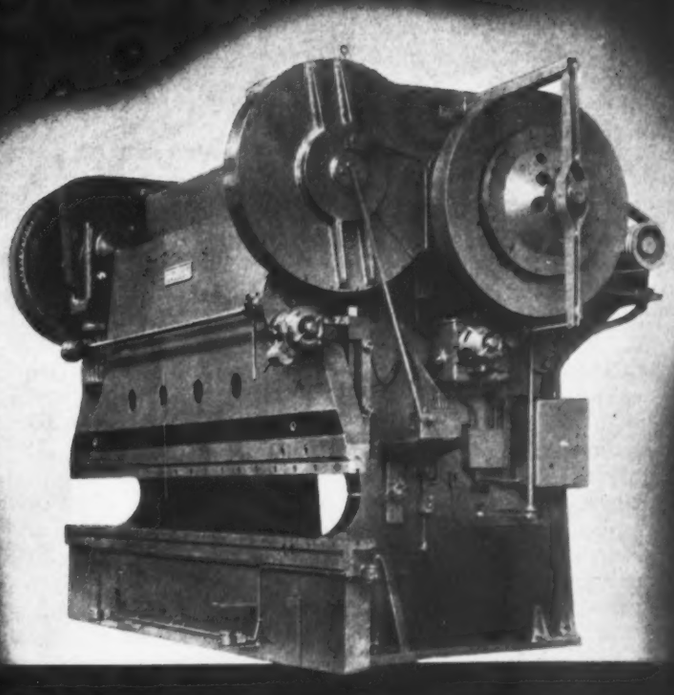
To obtain additional information on equipment described on this page, see lower part of page 160.

ARMOR PLATE

. . . Shear it on Cincinnati Shears
. . . Straighten it on Cincinnati Brakes

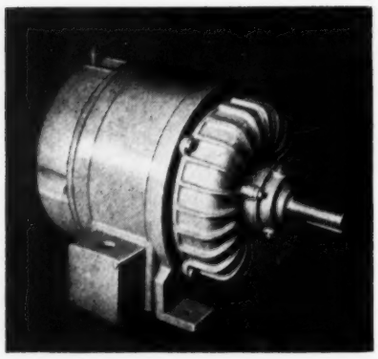
Write for recommendations based on our twenty years' experience in building Cincinnati Steel Press Brakes and Cincinnati All-Steel Shears for arsenals, navy yards, and manufacturers of armament.





THE CINCINNATI SHAPER COMPANY, CINCINNATI, OHIO

SHAPERS · SHEARS · BRAKES



Enclosed Fan-cooled Motor

"Meteor" Electric Hoist

Black & Decker "Holgun"

ment of a basic design power unit for machine tool motorizing equipment, designated as Torq-Qua-Matic drives.

The new motor is an alternating-current, polyphase, squirrel-cage type, and is built to NEMA specifications. The all-welded copper rotor is dynamically balanced on an alloy-steel shaft. Ball bearings are employed throughout.

Being completely enclosed, the windings of this motor are fully protected against dirt and dust. The air cooling system is designed to keep the motor running cool, even under the heaviest loads. 63

Clark Compact Fork Type Truck

The Clark Tructractor Division of the Clark Equipment Co., Battle Creek, Mich., has developed a low-priced, compact, fork type power truck designed to lift, carry, and tier heavy loads and to operate efficiently in congested areas, limited-capacity elevators, transport trucks, freight cars and on ramps. This truck, designated as the "Clipper," is made in six models having capacities of 1000, 1500, and 2000 pounds, with standard finger lifting heights of 60 to 108 inches. Other special lifting heights can be provided.

These trucks are adapted for continuous service, being equipped with an economical four-cylinder industrial truck engine. The important features include front-wheel driving, rear-wheel steering, hydraulic lifting and tilting, self-starting, and hydraulic brakes. The driver has all controls within easy reach, thus permitting safe operation at speeds from one to seven miles per hour. 64

Chisholm-Moore "Meteor" Electric Hoist

The Chisholm-Moore Hoist Corporation, 120 Fremont Ave., Tonawanda, N. Y., has brought out a new CM "Meteor" heavy-duty electric hoist. The outstanding features of this hoist include streamline design, which provides compactness and eliminates excess weight; airplane type cooling fins, which quickly dissipate the heat generated by gears and load brake; fully enclosed, weather-proof design, which permits use either indoors or out; and fully enclosed safety type hook blocks. A specially designed electrical system that permits only 110 volts to pass through the push-button station is also employed. These hoists are available in capacities ranging from 1/2 ton up. 65

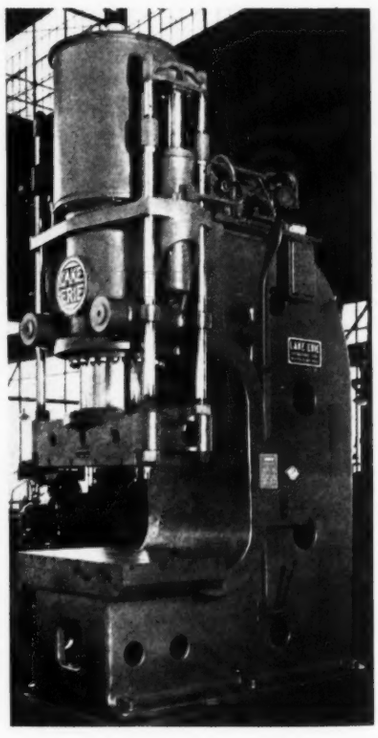
Black & Decker Heavy-Duty "Holguns"

The Black & Decker Mfg. Co., 735 Pennsylvania Ave., Towson, Md., has brought out a heavy-duty "Holgun" especially designed to meet the heavy production requirements of the aircraft industry and other industries having similar fabricating and assembly operations. The new "Holgun," made in four models, is adapted to a wide variety of 1/4-inch drilling operations. The models include an end-handle, heavy-duty, standard-speed and heavy-duty, low-speed type; and a side-handle, heavy-duty, standard-speed and low-speed type.

These units all have the "Holgun" features, and, in addition, have 50 per cent more power than the types previously available. The standard-speed, end-handle model weighs only 60 ounces and is 7 3/4 inches long. All units have two-pole, instant-release switches with Black & Decker pistol-grip and trigger-switch control, suitable for either right- or left-hand operation. The Black & Decker universal motors employed are ball-bearing equipped, and can be kept in continuous operation. 66

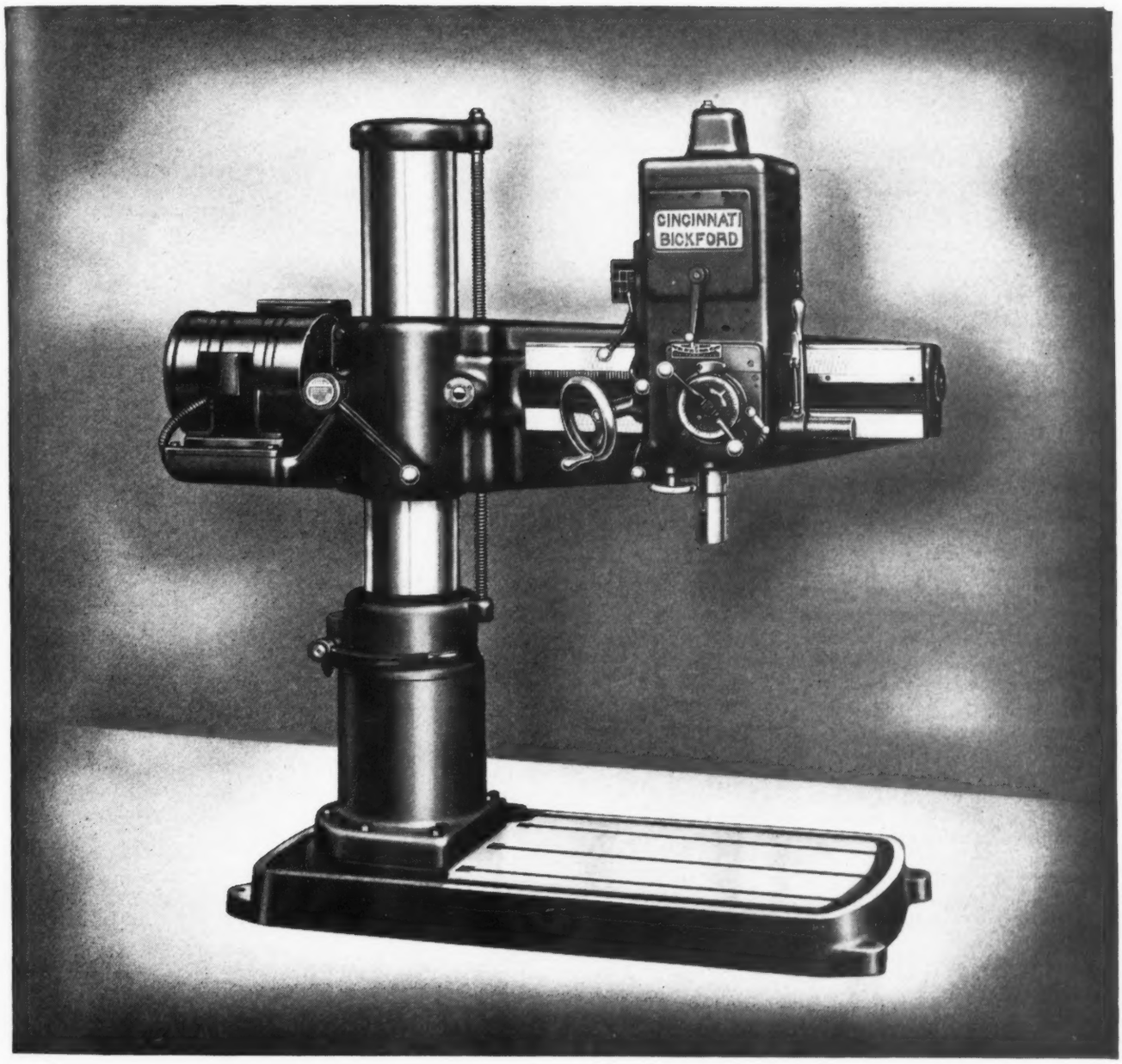
Hydraulic Plate-Bending Press

The Lake Erie Engineering Corporation, Buffalo, N. Y., has just brought out a 400-ton hydraulic



Lake Erie Hydraulic Plate-bending Press

To obtain additional information on equipment described on this page, see lower part of page 160.

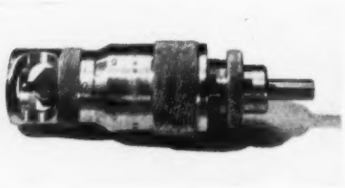


INCREASE YOUR PRODUCTION QUICKLY

with this 9" dia. column, 3' or 4' arm, High Speed Super Service Radial Drilling Machine. It can be obtained with any one of six different standard speed ranges containing nine spindle speeds . . . the fastest — 3500 RPM to 175 RPM . . . the slowest — 1200 RPM to 60 RPM. A single lever controls all speed changes. Speed and feed plates read directly. Drill diameters and corresponding spindle speeds are shown. There are four rates of power feed and five different methods of feeding the spindle by power feed, ratchet lever, knurled grip, quick return levers, and spot facing handwheel. The simplicity and ease of operation of this machine will surely increase your drill department output.

Write today for further information about this or our other radial or upright metal drilling machines.

THE CINCINNATI BICKFORD TOOL CO., Oakley, Cincinnati, Ohio



Micrometer-stop Countersink Made by Aero Tool Co.

plate-bending press that is especially adapted for use in the shipbuilding industry. The particular press shown in the illustration has recently been installed in one of the largest shipyards in this country. This is a self-contained machine, with the pumping unit mounted on top.

Handling of work is facilitated by the gap type C-frame of steel, designed to provide strength and rigidity. The throat depth is 30 inches; the stroke, 24 inches; and the daylight opening, 36 inches. A hand-lever provides the sensitive control of pressure essential for bending operations. 67

Newcomb-David Water Type Dust Collector

A water type dust collector has recently been placed on the market by the Newcomb-David Co., 5741 Russell St., Detroit, Mich. This equipment, known as the "Uni-Wash," has been designed to remove dirt, dust, fumes, and vapors from the air. It is particularly adapted for application in connection with grinding and polishing operations, and is also used in removing the explosive dust in finishing magnesium alloys. The dust collector is manufactured as a complete unit, ready for rapid installation either by the customer or by a local sheet-metal contractor. 68

Countersink Equipped with Micrometer Stop

Positive countersinking to a predetermined depth within a tolerance of 0.001 inch is possible with a new micrometer-stop countersink brought out by the Aero Tool Co., Burbank, Calif. Originally developed for aircraft plants, but also finding wide acceptance in all types of manufacturing, this instrument is said to permit greater accuracy than has previously been obtainable. It can be adjusted quickly and easily by a slight thumb pressure, and is said to cut a smoother, more accurate hole for flash rivets and screws without marring the metals.

The countersink is locked so rigidly in the desired micrometer position by a unique spring loading device that chattering and "walking" are eliminated. A ball thrust bearing assures smooth, even operation. The cutters are available in 3/8- and 1/2-inch diameter sizes, with included angles of either 82 or 100 degrees. 69

Amplifying Comparator Made by B. C. Ames Co.

Ames Amplifying Comparator

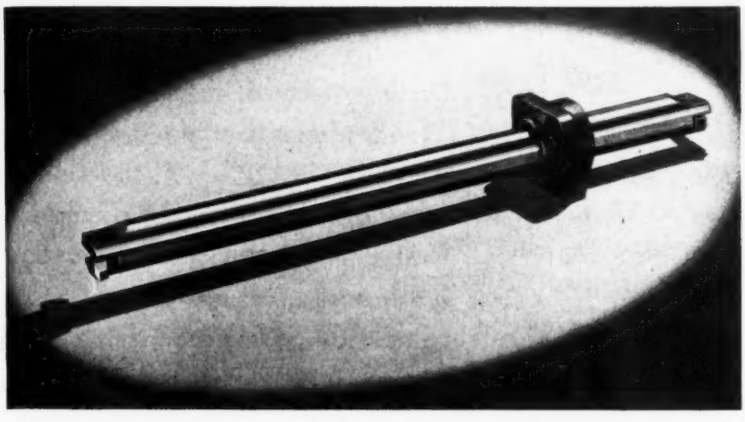
A precision-built comparator, mounted solidly on a large-diameter base and heavily constructed to eliminate spring, has recently been brought out by the B. C. Ames Co., Waltham, Mass. This comparator is intended for use in making comparisons of duplicate parts for size, and will indicate the most minute variations on the dial. Repeat readings can be easily obtained with this instrument.

The cast-iron base supports a steel column, which is grooved to provide an adjustable stop for the indicator bracket. Fine adjustment of the indicator is made by moving the dial with the outside lever. The adjustable stop assembly assists in locating the work on the hardened and ground anvil.

The height of the comparator is 15 inches, the base diameter 11 inches, and the total measuring capacity 6 inches. The fan-head indicator has a range of 0.002 inch. The distance from the contact to the front of the post is 3 1/2 inches. The weight is approximately 40 pounds. 70

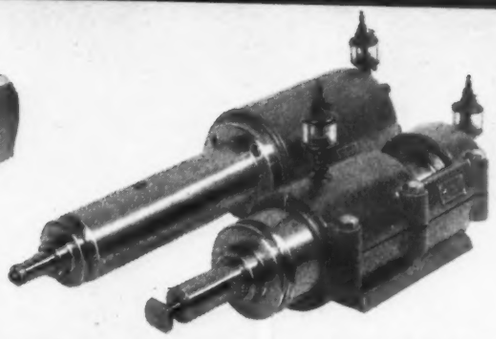
Gisholt Double-End Boring-Bar

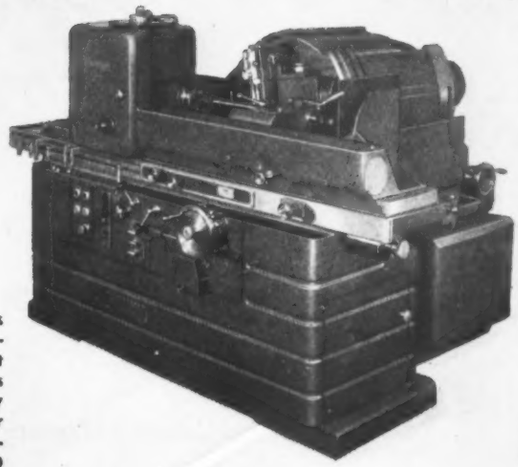
A double-end boring-bar designed for use with saddle type turret lathes has been placed on the market by the Gisholt Machine Co., 1209 E. Washington Ave., Madison, Wis. This boring-bar fits the standard flanged tool-holder on the turret, is passed through the turret, and is supported on the opposite side by a short holder having four screws, by means of which the bar is firmly gripped. This design provides a very rigid bar, with large single-point cutters adapted for use with the cross-feeding type of turret. 71



Gisholt Boring-bar for Saddle Type Turret Lathes

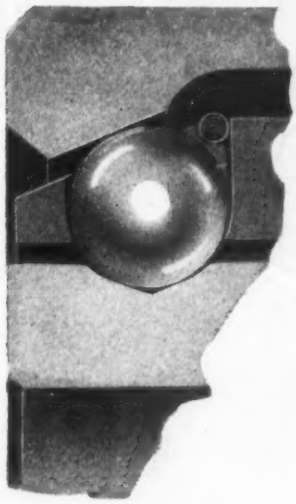
To obtain additional information on equipment described on this page, see lower part of page 160.





ABOVE: Ex-Cell-O motor-driven and belt-driven types of spindles. ***BELOW:*** Close-up view of Ex-Cell-O *Precision* Ball Bearing. Through the arrangement of point contact between the ball and the race, each ball is given a gentle spinning motion that results in every part of the surface of each ball being presented for wear. This minimizes bearing wear and aids in maintaining the spherical shape of each ball. Ex-Cell-O Precision Bearings on Ex-Cell-O Spindles are interchangeable as a unit.

Precision Boring as universally used today was developed mainly through the availability of the Ex-Cell-O *Precision* spindle. Above is Style 1212-A, one of nine standard Ex-Cell-O Precision Boring Machines featuring the Ex-Cell-O *Precision* Spindle.



Thread Grinding Machines, producing work to extremely close limits, must have *Precision* Spindles. Above is Style 35 Universal, one of eight styles of Precision Thread Grinders made by Ex-Cell-O, all equipped with Ex-Cell-O *Precision* Spindles.

TO LEFT: Ex-Cell-O Style 44 Carbide Tool Grinder, equipped with Ex-Cell-O inbuilt balanced motor spindle mounted in Ex-Cell-O *Precision* Ball Bearings.

TO RIGHT: Ex-Cell-O Center Lapping Machine, Style 74, for accurately conditioning female centers. This Ex-Cell-O machine also features the Ex-Cell-O *Precision* Ball Bearing Spindle.

PRECISION *begins with the* EX-CELL-O BEARING

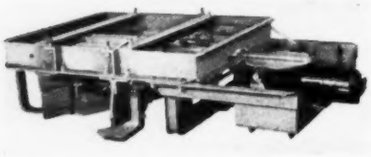
The greater accuracy, increased production, and better finish that a large number of manufacturers are obtaining today on Ex-Cell-O machine tools equipped with the Ex-Cell-O Precision Spindle can, to a great extent, be attributed directly to the superior features of the Ex-Cell-O spindle ball bearing—a bearing specially designed by Ex-Cell-O and precision fitted by patented Ex-Cell-O methods. For instance, many thousands of Ex-Cell-O grinding spindles with these special bearings are in daily operation throughout American industry—satisfactorily meeting all the demands made upon them by today's strenuous production pace. This is why many manufacturers of grinders use the Ex-Cell-O Precision Spindle as part of their original equipment, and why numerous metal-working plants throughout the United States insist upon the Ex-Cell-O Precision Spindle whenever spindle replacements have to be made.

EX-CELL-O CORPORATION • DETROIT, MICH.

THREAD GRINDING, BORING AND LAPPING MACHINES • TOOL GRINDERS • HYDRAULIC POWER UNITS • GRINDING SPINDLES • BROACHES • CUTTING TOOLS • DRILL JIG BUSHINGS • DIESEL FUEL INJECTION EQUIPMENT • R. R. PINS AND BUSHINGS • PRECISION PARTS

XLO

EX-CELL-O *means* PRECISION



Cleveland Electrically Operated Track Switch

Cleveland Motor-Driven Track Switch

An electrically operated track switch, known as the motor-driven Type H, has been developed by the Cleveland Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio, for use on cab-operated, gravity, or automatic dispatch overhead materials-handling systems. This development enables the tramrail operator to preset the switch at some distance ahead while traveling, and thus save time lost when switching by hand. Also, the switch can be used for the indexing of gravity or automatic dispatch carriers, which can be set to actuate trippers that will cause one or several switches to take the positions desired.

The switch is of welded steel construction and consists of two main assemblies — an outer supporting frame and an inner sliding frame. The outer frame is designed to be bolted rigidly to the superstructure. The inner assembly, carrying a straight and a curved rail, rides on multiple easy-operating rollers, and is set in position by a motor-driven cam through a lever arrangement.....72

Oxy-Acetylene Tip Designed to Increase Cutting Speed

A series of oxy-acetylene machine cutting tips designed to increase the cutting speed of machine

Airco "45" Cutting Tip in Use on Oxy-acetylene Cutting Machine

torches by 20 to 30 per cent and obtain cuts of a quality comparable to those obtained with standard tips has been developed by Air Reduction, 60 E. 42nd St., New York City. This new high-speed machine cutting tip, known as Airco "45," has a nozzle with a divergent exit portion, designed to eject a narrow, high-velocity stream of oxygen that is practically free of exit turbulence and that burns a narrower path or kerf through the metal than that produced by the conventional cutting tip.

As the oxygen stream penetrates the steel, its velocity is constantly dissipated. The divergent tip member increases the velocity of the oxygen stream and provides a higher carbon concentration at greater depths, thereby increasing the oxidation rate of the metal being cut. These new cutting tips are available in eight sizes ranging from 0 to 10 for cutting metal up to 8 inches thick. The tips are designed to fit standard machine cutting torches. 74

Portable Dynamic Balancing Unit

A portable dynamic balancing unit, designed to reduce vibration and noise in rotating machines assembled by mass production methods, has been brought out by the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This new balancing unit, known as Type HQ, consists of a sensitive wattmeter assembly, a sine-wave generator, a velocity type vibration pick-up, and the necessary connecting cords. This apparatus can be used over a speed range of from 600 to 10,000

Master Feed-Finger for Automatic Screw Machines

The Green Mfg. Co., 652 South St., Rockford, Ill., is placing on the market a master feed-finger for automatic screw machines that is distinctly different in design from conventional types. The finger, itself, is of solid construction and contains no moving parts or springs. A soft insert of rubber-like composition provides the gripping tension and prevents scratching of polished bar stock.

One of these master feed-fingers and a few inserts serve to cover the entire size and shape range of one machine. The feeding pads are pliable and will mold themselves to fit and grip stock of almost any conceivable shape. When the stock is fed against the machine stop, the soft pad acts as a cushion to absorb the shock, thus permitting the consistent maintenance of close length limits. ..73

Westinghouse Portable Dynamic Balancing Equipment

To obtain additional information on equipment described on this page, see lower part of page 160.

Milwaukee Model K Vertical Milling Machine

Tools That Put More Production Minutes Into the Hour.

KEARNEY & TRECKER CORP., MILWAUKEE, WIS., U. S. A.

KEARNEY & TRECKER CORPORATION

Milwaukee MILLING MACHINES

Milwaukee MILLING MACHINES

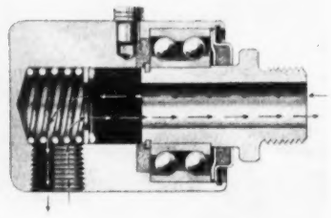
R.P.M., and by means of an auxiliary attachment the range can be extended downward to include 100 R.P.M.

To balance a rotating machine, the two-pole sine-wave movable-stator generator is coupled to the shaft of the rotor to be balanced. The pick-up is held against some part of the frame and produces a voltage that varies as the frequency and amplitude of the vibrations being measured. Amplitude and vibration phase angles are indicated on the wattmeter. 75

"Rotorseal" for Connecting Air or Oil Lines to Rotating Member

"Rotorseal" is the name of a device brought out by the Kellogg Division of the American Brake-Shoe & Foundry Co., 97 Humboldt St., Rochester, N. Y., to act as a positive seal at the point of transmission of air or oil under pressure or vacuum from a stationary member to a rotating member, or from a rotating member to a stationary member.

The "Rotorseal" consists of a shaft rotating in a sealed double-row ball bearing which is mounted in a housing, as shown in the illustration. The seal is achieved by a special non-metallic nose member which bears against the face of the rotating shaft. Bearing surfaces, lapped to insure a positive seal, are made self-adjusting by means of a spiral spring, which compensates for wear and maintains a constant and positive seal with minimum friction. The device is built to give long service without attention.



"Rotorseal" for Connecting Stationary and Rotating Pipe Lines

The "Rotorseal" can be run continuously in either direction, and can be reversed as often as necessary. It is suitable for use at pressures up to 150 pounds per square inch, at temperatures up to 200 degrees F., and at speeds up to 2000 R.P.M. It is made in five sizes, with passages ranging from 1/4 inch to 1 1/2 inches in diameter. 76

Wheel-Dressing Diamonds Set in Carbide Matrix

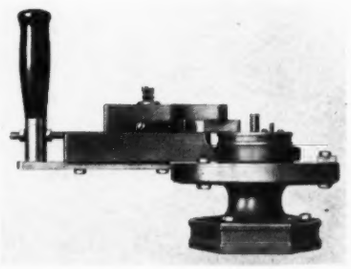
A method of mounting diamonds for grinding-wheel dressers in a matrix of sintered tungsten carbide has been developed by Dia-Tool, Inc., 320 Yonkers Ave., Yonkers, N. Y. The advantages claimed for this method of mounting wheel-dressing diamonds are: (1) The tungsten-carbide matrix grips the diamonds very tightly, due to the shrinkage that takes place during the sintering process. (2) The tungsten-carbide composition used has a coefficient of thermal expansion practically equal to that of the diamond; therefore, there is no loosening of the diamonds in their setting, due to heating and cooling of the tool. (3) The tungsten-carbide mounting permits the diamonds to be used up completely without loss, as they will not come out of the matrix. The Dia-Tool wheel-dressers are made in a number of shapes and sizes to meet practically every requirement in the grinding industry. 77

"Di-Acro" Bender, Brake, and Shear Units

Recently developed models of the bender, brake, and shear units made by the O'Neil-Irwin Mfg. Co., 316 Eighth Ave. S., Minneapolis, Minn., are now available with adjustable bearings and other improvements designed to insure easier operation and higher production rates. These improved units are to be known as "Di-Acro" benders, brakes, and shears.

The "Di-Acro" bender, shown in the illustration, can be used to produce duplicates of many varieties of metal pieces, serving as a substitute for forming dies. This unit will take, without alteration, simple shop-made conversions for forming angles; channels; rods; round, hexagon, or square tubes; half-round or flat wire; and strip stock, either on edge or flat. Moldings and various other parts of open or partially open cross-section, of regular or irregular outline, can also be formed.

The weight of the No. 1 bender is 20 pounds. The capacity is sufficient for cold-forming 1/4-inch round cold-rolled steel bar stock to a radius of 1/2 inch. Tubing 5/16 to 3/8 inch in outside diameter, depending upon the wall thickness,



"Di-Acro" Two-way Forming Bender

can be formed to a radius of 1 inch. A larger No. 2 bender, weighing 145 pounds, is available for bending round cold-rolled steel up to 1/2 inch in diameter to a radius of 1 inch.

The No. 1 "Di-Acro" brake, weighing 30 pounds, has a maximum folding width capacity of 6 inches, and will make folds up to an angle of 110 degrees. This brake will fold 16-gage steel plate in widths up to 6 inches. A larger No. 2 brake of the same design, weighing 110 pounds, is available, which has a folding width capacity of 12 inches, and will handle 16-gage steel, making angular folds of 110-degrees.

The No. 1 "Di-Acro" shear, weighing 30 pounds, has a maximum shearing width capacity of 6 inches, and will handle 22-gage steel plate. 78

Porter-Cable Belt Grinder

A small abrasive-belt sander-grinder using a belt 4 inches wide by 45 inches in circumference has been added to the line built by the Porter-Cable Machine Co., Syracuse, N. Y. This new grinder (Type G-4) is so equipped that it can be used either with dry belts or with the new type resin-bonded abrasive belts on which water or

To obtain additional information on equipment described on this page, see lower part of page 160.

New Victories for these NEW TURRETS!

Look ahead . . keep ahead . .
with Gisholt improvements
in metal turning

We've been advancing rapidly all along the machine tool front—winning new victories over shortages of time and manpower on hundreds of machining operations.

Yes, today the new Gisholt Turret Lathes are turning metals for many vital parts in less than one-half the time required only a few years ago. And with far greater accuracy, too!

That's progress—the kind of progress that is backing up America's swift-moving defense program! And it's the kind of progress that is important to you, as a manufacturer.

When you plan increasing production, now or in the future, investigate the many ways these new Gisholts can save minutes, manpower, and money.

GISHOLT

GISHOLT MACHINE COMPANY

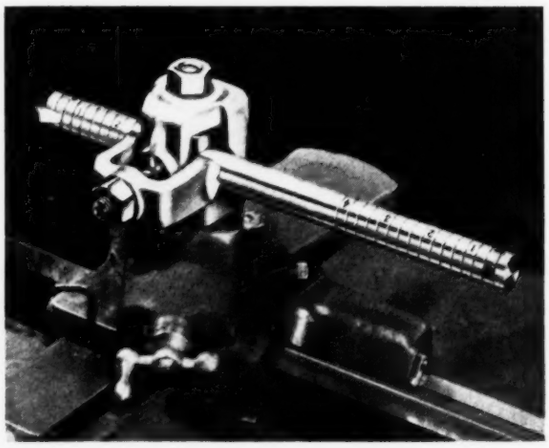
1209 EAST WASHINGTON AVENUE • MADISON, WISCONSIN

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

other coolant is sprayed. It is recommended for sanding or grinding small parts of wood, metal, plastic, glass, fiber, hard rubber, or other materials on which a clean, uniform surface is desired or which are to be squared or radius-formed. Many light milling and grinding operations can also be performed on this machine.

A 3/4-H.P., 1725-R.P.M., ball-bearing, totally enclosed motor, directly connected to the drive pulley of the grinder, gives a belt speed of 3400 surface feet per minute, traveling over a flat backing plate 4 inches wide by 10 inches long.

Two convenient hand adjustments simplify the application, removal, and alignment of the abrasive belts. The entire interior of the machine is accessible through the removal of a side guard. The complete unit is mounted on a cast-iron pedestal and is readily portable. The slotted rest table can be adjusted to any angle up to 45 degrees. 79



Boring-bar Holder Made by Clayton Mfg. Co.

Clayton Boring-Bar Holder

A new boring-bar holder having a two-way locking device, with the boring-bar lock independent of the clamp which locks the holder to the lathe, has been designed by the Clayton Mfg. Co., Alhambra, Calif. With this holder, any size bar within the rated capacity can be quickly aligned and clamped in place.

Bars can be changed, tool bits raised or lowered, or distances between the tool bit and the body of the holder changed without disturbing the alignment of the holder with the lathe. The holder can be removed from the lathe with the boring-bar setting retained intact for later duplicating operations, thus eliminating the necessity for complete realignment. The bars are permanently graduated in 1/4-inch calibrations to indicate the depth of the bore. Five sizes of holders, suitable for lathes ranging in size from 9 to 28 inches, are available in complete sets with boring-bars or as individual tools. Boring-bars are available in diameters of from 3/8 inch to 2 1/2 inches. 80

* * *

Advertising is a specialized technique for mass communication. It exists for two reasons—because it is fast, and because it costs less than any other method.—*H. A. Batten in Printer's Ink*

Saving Materials and Tools in the National Emergency

Henry Disston & Sons, Inc., Philadelphia, Pa., is offering to American industries a Conservation Control Plan designed to conserve tools and materials and to speed up production. The plan has had the approval of the Office of Production Management. It is based upon instruction cards called "Conservation Control Cards"; these cards tell the individual worker how to handle a particular tool, how to use it efficiently, how to keep it from breaking, and how to sharpen it. It also gives other important information that will insure easier and better work.

There are thirty-five of these cards covering cutting tools for metal, wood, and plastics, including tool bits, files, hacksaw blades, carbide cutting tools of all kinds, circular and band saws for metal and wood, etc. These cards are supplied free by Henry Disston & Sons, Inc., to any plant making a request. In addition, there are posters prepared for the use of plants to "sell" the idea to the men in the shop. Emphasis is put on the importance of saving materials in order to make more materials available during this time of emergency and avoid shortages both for war and civilian uses. The company emphasizes that it is not necessary to be a Disston product user to obtain these cards and posters.

* * *

Lock-Washers Made to Order in Small Quantities

In much of the war equipment now being made, special lock-washers are required, including thrust washers made from various alloys. The Dayton Rogers Mfg. Co., Minneapolis, Minn., has developed methods for producing special stamped lock and thrust washers in lots as small as one hundred. It is stated that the cost of washers made in such small quantities in special dies is less than one-tenth that of washers made in small lots by hand methods. These washers are made in sizes from 1/2 to 12 inches in diameter from various alloy sheets.

* * *

McKenna Metals Announces Price Reductions

The McKenna Metals Co., Latrobe, Pa., has announced a price reduction in Kennametal tools and tool blanks. The reduction became effective January 5. The company increased its production in 1941 fivefold. This increase in production has permitted a reduction in price of from 20 to 30 per cent for the sizes of blanks generally required for steel-cutting lathe and boring tools. The prices of complete tools with Kennametal tips brazed on steel shanks have also been reduced. Price list No. 7 issued by the company covers the present prices.

To obtain additional information on equipment described on this page, see lower part of page 160.

ZINC IN WAR

Loading a gun with 3-inch shells. U. S. Navy photo

BRASS, BRASS AND MORE BRASS

The United States Army and Navy have no satisfactory substitute for brass shells and cartridges. Nor is there any substitute for the high grade zinc used in ordnance brass.

When shell charges are detonated, brass casings heat rapidly to expand and seal the gun breach; then in cooling quickly they shrink to permit easy ejection. It is questionable whether this action can be obtained with any other metal.

From a manufacturing standpoint, it is essential to use 30% of high grade zinc in shell brass to achieve the proper degree of ductility and formability. These properties are necessary to withstand the deep drawing operations employed in forming shell cases in automatic machines.

The fact that one shell of 5-inch diameter requires 18 pounds of brass is impressive. But when the millions of cartridge and shell cases for automatic rifles, machine guns, anti-aircraft and mobile artillery are considered, then the total zinc tonnage required for the Victory Program can be more fully appreciated.

It is this tonnage, plus the war needs for other products normally consuming zinc, which is making it difficult for civilian users to obtain all of the zinc they would like to use.

THE NEW JERSEY ZINC COMPANY

MANUFACTURERS OF THE FAMOUS HORSE HEAD ZINC PRODUCTS

4 BRASS
CERAMICS
DIE CASTING
METAL SPRAYING
GALVANIZING
PHARMACEUTICALS
NICKEL SILVER
1 HULL PLATES
2 RUBBER
3 PAINT

New Jersey zinc

Electrical Heating Unit Used in Shell Production

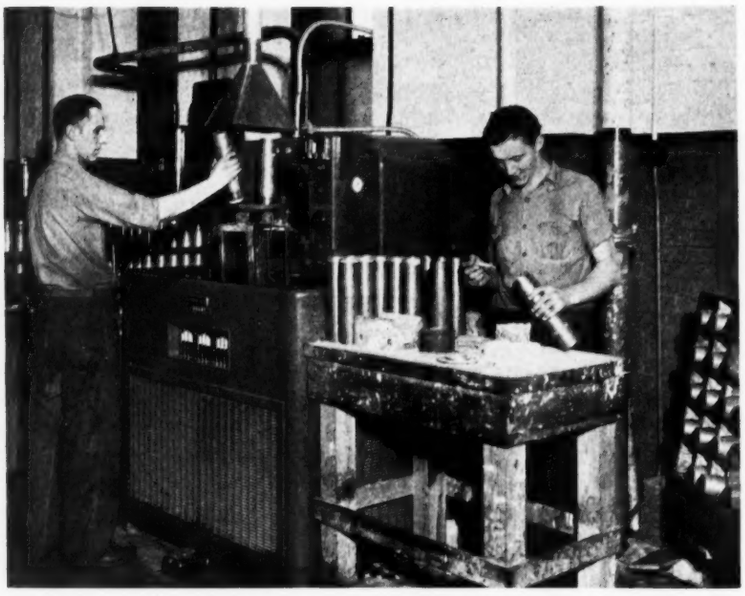
THE installation of new electrical induction heating equipment for the brazing of adapters to shells has resulted in a remarkable increase in production in a Pennsylvania munitions plant. With this new equipment, one operator can heat two shells simultaneously in fifty seconds. The heating methods formerly employed required at least five minutes or more for one shell. This improvement in output is obtained on a Tocco electrical induction heating unit made by the Ohio Crankshaft Co., Cleveland, Ohio. This Tocco process of silver-soldering shells is not only twelve times faster than methods previously used, but, in addition, has reduced the number of rejected shells to one or two per thousand.

The shells are placed nose down in a twin inductor, mounted on a small size 20-kilowatt Tocco Jr., utility unit which is equipped with a 9600-cycle motor generator set with a 220-volt hook-up. Automatic controls govern the brazing cycle to a split second, eliminating the danger of overheating. With this equipment, the power costs are extremely low. Two men perform the entire fluxing, adapter-fitting, soldering, and handling operations. The heating units can be readily converted for surface hardening by merely mounting suitable inductors on the transformers, which are adapted for the hardening, heating, and quenching cycle.

An important feature of the induction brazing process is the control of the heat to within a 1/4-inch band on either side of the joint. Operators can handle shells with their bare hands, without the use of tongs, no prolonged cooling off period being necessary.

A ring-formed strip of silver solder is slipped into the recess in the adapter. Then a thin layer of flux is brushed on and the adapter is screwed down tightly by hand. The threaded joint is carefully cleaned with carbon tetrachloride before these operations are performed, and the adapter flanges and nose face of the shell are cleared of any burrs or slight nicks by filing. Grease or dirt must also be avoided.

To prevent inner shell corrosion resulting from the soldering fumes created by the flux, automatically controlled air jets are made to shoot upward into the shells, so that they are thoroughly cleaned. It is stated that an exposure of only ten minutes to these caustic fumes will result in detrimental corrosion. Rejections average no more than two per thousand shells, these being traceable in most cases to a dirty seal face or thread burr.



Tocco Jr., Electrical Induction Heating Unit Equipped for a Shell Brazing Operation

Excess solder on the outer shell surface is turned off on an automatic lathe, leaving the adapter joint so smoothly finished that it cannot be detected by visual inspection.

Induction brazing is also being used for brazing collars to burster tubes and for brazing aviation engine accessories, fuselage parts, tubes, and flanges. Increased speed, uniformity of results, control of the heat, reduction in operating costs, and the use of unskilled labor are some of the advantages obtained by induction brazing.

* * *

Blackout Paint for Industrial Plants

A blackout paint that is said to meet all the requirements for ease of application, obscuring of light and reflections, simplicity of removal, and economy has been brought out by the Midland Paint & Varnish Co., Cleveland, Ohio. The new product, known as P-40 blackout paint, is intended for outside application. The inside painting of glass is not recommended by the company, since light reflections and halations would still be visible even for long distances. Reports from aviators indicate that even moonlight reflected from glass is effective as a guide for the aviator.

It is said that the new paint is resistant to heat, unaffected by sun rays, and that water or moisture will not affect it. It can be easily removed from glass windows simply by wiping it off with an inexpensive solvent.

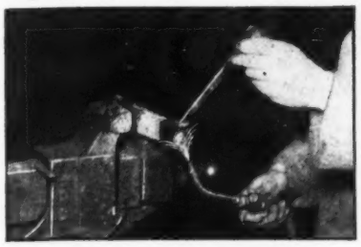
* * *

Shell-Nosing Dies Made from Graphitic Steel

Nosing dies made from graphitic steel produced by the Timken Roller Bearing Co. are being used in a shell-forging shop with remarkable results. Several of these dies employed for cold-nosing 105-millimeter shells have operated on 50,000 pieces each, without showing any appreciable signs of wear. Previously, 4000 shells was regarded as the maximum shell-nosing die performance.

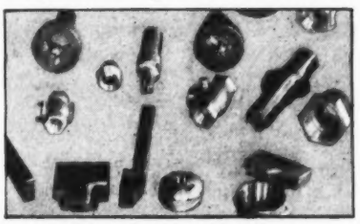
For Rush Tooling Braze Your Own Carboloy Tools

When you need tools in a hurry—when a job demands immediate tooling—mill, braze and grind your own Carboloy tools! Three simple operations, done in your own tool room—and the tool is on the job. It's *fast*—less than an hour is required for most single-point, straight-shank tools.



It eliminates ordering time and "hold-ups" awaiting deliveries.

Keep a stock of Carboloy Standard blanks in your tool crib . . . ready at a moment's notice to make up tools. You simply recess a shank to accommodate the Carboloy blank—braze in the blank—and grind the brazed tool.



Typical Carboloy tools made by a brass goods manufacturer.

With these three simple steps you're prepared to meet emergency tooling immediately.

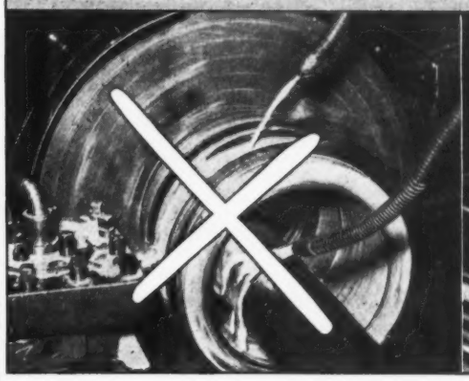
A new 32-page Carboloy Tool Manual, No. GT-133, shows you exactly how to do the job and also

STANDARD CARBOLOY BLANKS

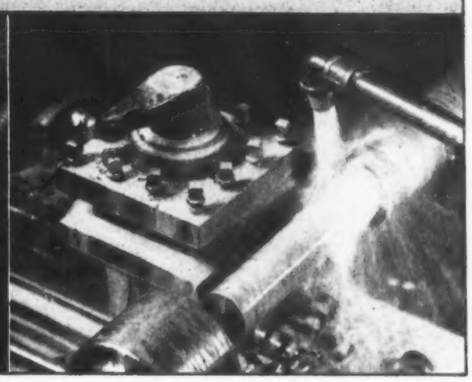
65 SIZES
2 STYLES
3 GRADES

contains data essential for subsequent use and maintenance. This manual, with Carboloy Standard Tool and Blank Catalog, No. GT-140, listing Carboloy Standard Blanks—65 sizes, 2 styles, 3 grades—sent upon request.

When You Use Coolant with Carbide Tools — Use *PLENTY* of It!! —



A weak stream of coolant is ineffective and results in reduced tool life.



An ample volume of coolant at high velocity carries away heat rapidly and continuously.

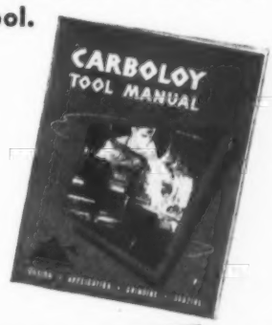
TO INSURE best results when you use coolants with cemented carbide tools, always provide an ample flow of sufficient volume and velocity to reach, and adequately cool, the cutting edge of the tool. A weak, thin stream may often do more harm than good since the high speeds used with carbide tools—usually above 200 feet per minute—may cause most of the coolant to be carried away from the work before it reaches the point of the tool.

If you want to provide best possible conditions for efficient use of coolants do these two things:

USE VITAL CEMENTED CARBIDES EFFECTIVELY!

1. **Make sure that coolant pump, tank, and supply pipes are of sufficient capacity to maintain large flow at high velocity *without appreciable rise in coolant temperature.***
2. **Make sure that coolant is actually reaching the cutting edge of the tool by providing adequate velocity and directing flow along an unobstructed path directly towards point of tool.**

For complete details and sketches, consult page 20 of Carboloy Tool Manual No. GT-133, available upon request, without obligation.



CARBOLOY COMPANY, INC.
11147 E. 8 MILE AVE., DETROIT, MICH.
Chicago • Cleveland • Los Angeles • Newark • Philadelphia
Pittsburgh • Worcester, Mass.
Canadian Distributor: Canadian General Electric Co., Ltd., Toronto, Canada

CARBOLOY Reg. U.S. Pat. Off.
CEMENTED CARBIDES
TOOLS - DIES - DRESSERS
CORE BITS - MASONRY DRILLS
- WEAR RESISTANT PARTS -
FOR THE MANUFACTURING · MINING · TRANSPORTATION · CONSTRUCTION INDUSTRIES

NEWS OF THE INDUSTRY

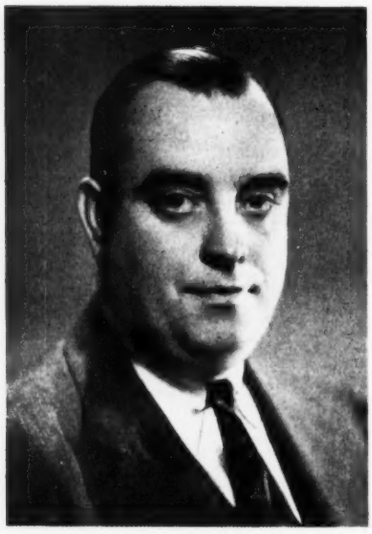
California

J. O. ELLISON has been appointed sales manager of the Fray Machine Tool Co., Glendale, Calif. Mr. Ellison was previously connected with the Smith Booth Usher Co. in Los Angeles, and has recently been in charge of all government orders, as well as other company sales.

HALL L. HIBBARD, vice-president and chief engineer of the Lockheed Aircraft Corporation, Burbank, Calif., was elected president of the Institute of Aeronautical Sciences for 1942 at a recent meeting of the Council.

Illinois and Indiana

SUNDSTRAND MACHINE TOOL CO., Rockford, Ill., announces the release of A. M. JOHNSON for the duration of the emergency to serve with the Office of Production Management at Washington, D. C. Mr. Johnson received an appointment to the technical staff of this office, and took over his duties on January 2. He is widely known in the machine tool industry, having been associated with it for nearly twenty years. He has been a member of the Sundstrand organization for about seven years, over a year of which he traveled in Europe. Previously he was connected with the Covel-Hanchett Co. of Big Rapids, Mich., where he served in engineering work and as sales manager of the Covel Mfg. Co., a subsidiary of the former concern.



A. M. Johnson, of the Sundstrand Machine Tool Co., Who is Now Serving on the O.P.M.

VICTOR E. METZGAR, formerly with the Lockheed Aircraft Corporation and the Stearman Aircraft Co., is now chief sales engineer in charge of the metal-working machinery division of Onsrud Machine Works, Inc., Chicago, Ill.

Victor E. Metzgar, Chief Sales Engineer of Metal-working Machinery Division of the Onsrud Machine Works

JOHN H. DAVEY, who has been connected with the Chicago office of the Brown & Sharpe Co. for a number of years, retired on January 1 after forty-six years of active service in various capacities with the Brown & Sharpe Mfg. Co. and its subsidiary, the Brown & Sharpe Co.

R. E. BINGMAN has been appointed district manager of the Indiana territory for the Jessop Steel Co., Washington, Pa. His headquarters will be at 617 Architects and Builders Bldg., Indianapolis, Ind.

A. W. HERRINGTON, president of the Marmon-Herrington Co., Inc., Indianapolis, Ind., has been elected president of the Society of Automotive Engineers for the year 1942.

New England

R. D. LAWSON has been appointed salesman by the Machine Division, Norton Co., Worcester, Mass., for northern New England, including the states of Vermont, New Hampshire, Maine, and parts of Massachusetts and Rhode Island. He succeeds W. E. WICKSTROM, who takes over sales engineering work at the main office in Worcester. JAMES K. STEVENSON and PAUL F. SPARROW have been appointed salesmen for the Refractories Division of the company, with headquarters in Chicago and Pittsburgh, respectively.

BENJAMIN F. ELLIS, one of the founders of the Waltham Machine Works, Waltham, Mass., has retired on account of illness. In 1898 Mr. Ellis and EDMUND L. SANDERSON formed a partnership known as the Waltham Machine Works for building machines and tools. The business will be continued as before by Mr. Sanderson and his new partner, EDWARD BLAKE.

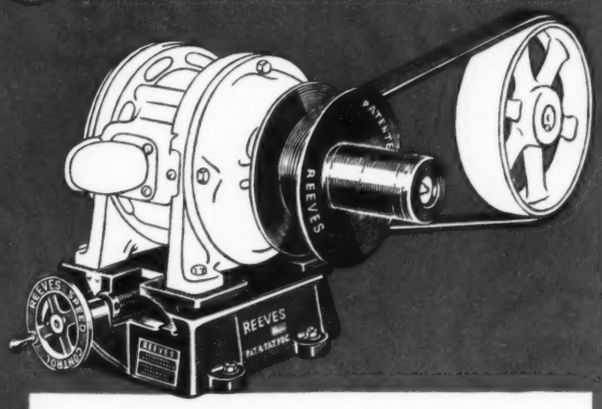
WALLACE N. GUTHRIE has been elected executive vice-president and has been appointed general manager of the Cuno Engineering Corporation, Meriden, Conn. He has been with the company on a part time basis for the past year in connection with work now being done by Stevenson, Jordan, and Harrison, Inc., New York City, industrial and management engineers, of which he is a partner. From now on he will devote his full time to his new position.

H. MANSFIELD HORNER, general manager of the Pratt & Whitney Aircraft Division of the United Aircraft Corporation, East Hartford, Conn., was elected a vice-president of the corporation at a recent meeting of the board of directors.

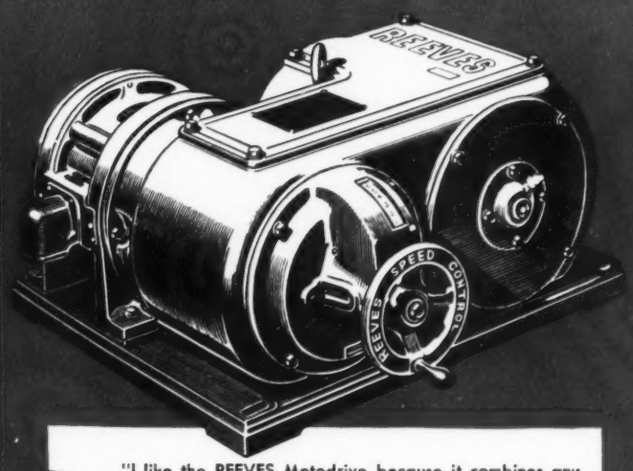
New York and New Jersey

OAKITE PRODUCTS, INC., 22 Thames St., New York City, manufacturers of industrial cleaning materials, announce the addition of two newly created divisions to its field service staff, in order to meet the increased needs for its services and products in New England and the southwest. The New England Division, with headquarters at the Capitol Building, 410 Asylum St., Hartford, Conn., is headed by T. R. SMITH, newly appointed division manager. The other new Oakite division is the St. Louis and Southwestern Division, which will make its headquarters in St. Louis. S. C. SHANK, Oakite service representative in the Toledo, Ohio, territory since 1930, has been selected to fill the post of manager of this division.

"I like the REEVES Variable Speed Transmission because it provides accurate speed adjustability over wide range —2:1 through 16:1—and because its rugged construction makes it ideal for heavy duty service."



"I like the REEVES Vari-Speed Motor Pulley because it is easily applied to the standard shaft extension of any constant speed motor and forms a direct drive to the driven machine." Speed variation within 3:1; fractional to fifteen horse power capacities.



"I like the REEVES Motodrive because it combines *any* standard constant speed motor, the Reeves speed-varying mechanism and reduction gears (if required) in one compact, modern unit." Speed variation 2:1 through 6:1; fractional to ten horse power capacities.

MOST POPULAR

—and here are the reasons why

● It has become the habit for plant men, when they think of variable speed control, to think of REEVES.

In fact, when they see a variable speed drive on a machine, they CALL it a REEVES. And they're usually right.

More REEVES units are in service today than all other makes combined—150,000 in 18,000 plants. The builders of 1435 different makes of machines regularly supply REEVES Speed Control as standard equipment.

It is entirely logical for REEVES to occupy this position of recognized leadership! REEVES originated the variable speed transmission—pioneered the field—has specialized for years in speed control engineering.

Only REEVES offers a complete line of speed control equipment—built around three basic, highly adaptable units (pictured here) from which you can choose the best unit for your individual requirements.

Only REEVES has a nation-wide staff of seasoned, factory-trained speed control engineers, who devote their full time and attention to the correct application and servicing of variable speed control.

—And no other method of variable speed control provides the same fine selectivity and dependability as does the REEVES—infinite speed adjustability that is *accurate and positive over the full speed range.* Write for 124-page Catalog-Manual G-419. Most comprehensive book on speed control ever published.

REEVES PULLEY COMPANY, *Dept. M,* **Columbus, Indiana**

ACCURATE
POSITIVE *Reeves*

SPEED CONTROL

GEORGE P. PASSMORE has been made works manager in charge of manufacturing of the Wellsville, N. Y., Works of the Worthington Pump & Machinery Corporation, Harrison, N. J. He was previously manager of manufacturing of the South Philadelphia Works of the Westinghouse Electric & Mfg. Co.

VANDYCK CHURCHILL CO., 114 Liberty St., New York City, has been appointed exclusive sales agent for BAKER BROS., INC., Toledo, Ohio, manufacturers of drilling machines, keyseaters, and contour grinders. The agency covers eastern New York State and the metropolitan area.

W. J. CALNAN, H. D. TIETZ, and E. A. TURNER have been appointed assistants to J. F. McNamara, Monel sales manager of the International Nickel Co., Inc., 67 Wall St., New York City. H. E. SEARLE, formerly an assistant to Mr. McNamara, has been transferred to the nickel sales department.

W. H. WILLS, chief metallurgist of the Allegheny-Ludlum Steel Corporation, with headquarters at Dunkirk, N. Y., recently gave a talk on "Molybdenum High-Speed Steels" before the South Bend, Ind., and Rochester, N. Y., chapters of the American Society of Tool Engineers.

FRANK H. BOYD, for thirty years divisional manager in the Cleveland territory of the American Seating Co., has been appointed sales manager of the S. G. Frantz Co., Inc., 161 Grand St., New York City, manufacturer of magnetic separators.

F. L. CURTIS, general manager of the Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J., has been appointed vice-president of Raybestos-Manhattan, Inc. Mr. Curtis has been connected with the company since its beginning in 1893. He will continue to serve as treasurer of the company. H. E. SMITH, assistant general manager of the Manhattan Division, will succeed Mr. Curtis as general manager, and J. H. MATTHEWS, previously assistant factory manager, will become assistant general manager.

Ohio

CINCINNATI BICKFORD TOOL CO., Oakley, Cincinnati, Ohio, is erecting a large addition to its plant which will provide 75,000 additional square feet of floor space. The new building has been necessitated by the constantly increasing demand for the company's drilling machines. In the early part of last year, the company added a substantial addition, in order to take care of its business, which, in 1940, was twice as large in shipments as in any previous year, and in 1941 was increased by 75 per cent over 1940.

BARGAR SHEET METAL CO., 12401 Euclid Ave., Cleveland, Ohio, has recently completed an extensive expansion of the company's production facilities in order to supply machine guards, gear casings, pans, and housings to machine tool builders and other machinery manufacturers on a production basis. Both forming and welding processes are made use of in such a manner that the guards appear on the outside as seamless.

GEORGE E. MARKLEY has been appointed sales manager of Radiant-Combustion, Inc., Warren, Ohio, manufacturer of gas-fired industrial furnaces. He was formerly sales engineer of the North American Mfg. Co., manufacturer of combustion equipment and blowers. THORN PENDLETON, president of the Warren Tool Corporation, will also serve as president of Radiant-Combustion, Inc., in place of CLARENCE MORAN, who has resigned.

S. P. FLENNIKEN, JR., formerly district manager of the Indianapolis office of the Berger Mfg. Division of the Republic Steel Corporation, Canton, Ohio, has been made branch office manager in Chicago for the company, succeeding WILLIAM A. HARRIS, JR., who has resigned. ALLEN C. RUDY, of the Chicago sales staff of the Berger Mfg. Division, becomes district manager of the Indianapolis office in Mr. Flenniken's place.

JAMES F. LINCOLN, president of the Lincoln Electric Co., Cleveland, Ohio, started January 12 on a war industry speaking tour, during which he will visit seventeen cities to speak before production men, manufacturers, and engineers on methods of speeding war production by means of arc welding.

H. E. GROUT has been appointed superintendent of the Small Motor Division of the Westinghouse Electric & Mfg. Co. at Lima, Ohio. He was previously general foreman.

Pennsylvania

E. G. GRACE, president of the Bethlehem Steel Co., Bethlehem, Pa., has been awarded the Bessemer Gold Medal for 1942 by the British Iron & Steel Institute in recognition of his achievements in "fostering collaboration between the steel industries of two leading nations in a great world crisis." The Bessemer Gold Medal was founded in 1874 in honor of Sir Henry Bessemer. It has become the most highly prized international award for achievement in the steel industry. The medal has been awarded previously to only three other Americans—Andrew Carnegie, Charles M. Schwab, and Albert Sauveur.

BALDWIN LOCOMOTIVE WORKS, Philadelphia, Pa., announces the appointment of four divisional vice-presidents, as follows: HALDWELL S. COLBY, locomotive division; FRANK K. METZGER, Standard Steel Works division; FREDERICK G. SCHRANZ, Baldwin Southwark division; and NORRIS H. SCHWENK, Cramp Brass and Iron Foundries division. Their duties will remain substantially the same as in the past. Other appointments in the locomotive division include that of AMOS G. COLE, works manager, and LEWIS W. METZGER, production manager.

WYCKOFF DRAWN STEEL CO., with plants at Ambridge, Pa., and Chicago, Ill., has received the Navy "E" pennant and the flag of the Bureau of Ordnance. The notification to the company mentions that this is "in recognition of outstanding effort in the production of ordnance material vital to our war effort."

W. L. KENNICOTT, previously Los Angeles sales manager of the McKenna Metals Co., is now at the head office and factory at Latrobe, Pa., where he has charge of managing sales and engineering of Kennametal tools and their applications.

Wisconsin and Michigan

MAX W. BABB, president of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., was elected chairman of the

Max W. Babb, Newly Elected Chairman of the Board of the Allis-Chalmers Mfg. Co.

Keep 'em Cutting...Longer...Faster

SUNOCO EMULSIFYING CUTTING OIL PERMITS HIGHER P-Q* FOR PRESENT MACHINES

This is no time to worry over priorities on machine tools. Your urgent job is to set and maintain a higher P-Q* (Production Quota) with present equipment . . . and SUNOCO EMULSIFYING CUTTING OIL will help you do it!

SUNOCO has long been the choice of the leaders in the metal working industry. They know SUNOCO's high lubricating and heat absorbing qualities permit more pieces per tool grind . . . enable machine tools to operate at rated capacity plus . . . make possible finer finishes, closer tolerances, fewer rejects.

Let SUNOCO help you set a higher Production Quota. Call in a SUN "Doctor of Industry" — a metal working expert. Let him prove the merits of SUNOCO for stepping up production in your own shop . . . under your own operating conditions. Write today to SUN OIL COMPANY, Philadelphia, Pa.

*Production Quota

LET'S GO! U.S.A. KEEP 'EM FLYING!

PERFORMANCE DATA

OPERATION — Turning 3½" bar

MACHINE — Warner & Swasey 2-A Universal Heavy Duty Turret Lathe

CUTTING LUBRICANT — 1 part Sunoco to 20 parts water

SUNOCO

SUN PETROLEUM PRODUCTS HELPING INDUSTRY HELP AMERICA

board of directors at a recent meeting of the board. W. C. BUCHANAN, a director and member of the executive committee, was elected president to succeed Mr. Babb.

RALPH H. DEIHL has been appointed advertising manager of the Falk Corporation, Milwaukee, Wis., manufacturer of gears, speed reducers, and flexible couplings.

PONTIAC MOTOR DIVISION OF THE GENERAL MOTORS CORPORATION is the first automobile manufacturer to receive the Bureau of Ordnance flag and the Navy "E" pennant for "outstanding efforts in production of ordnance material vital to our national defense." The company is privileged to fly the flag and the pennant as evidence of outstanding achievement.

MURCHEY MACHINE & TOOL CO., Detroit, Mich., manufacturer of threading tools and machines, announces the election of the following officers for the year 1942: President, A. J. PRANCE; vice-president, M. C. MURFIN; secretary, W. C. BEECHNER; and treasurer, J. N. LORD.

* * *

Price Reduced on Carboloy Standard Tools and Tips

With the completion of its second plant expansion in six months, the Carboloy Company, Inc., Detroit, announces a second price reduction on standard Carboloy tools and tips on which mass production was started only a little over a year ago. The latest and most important expansion of the Carboloy plant was designed to provide greater productive capacity for carbide metals and tool tips. The company is striving to change an even greater percentage of its cutting tool and tip business from "specials" to "standards." The price reductions, therefore, anticipate an increase in the total output of Carboloy tools.

The price reductions, which became effective January 1, include standard tools above 3/8 inch and standard tips above 3 grams. The price reductions on blanks also affect special tools on which such blanks are used.

* * *

The American Gear Manufacturers Association reports that industrial gear sales for December, 1941, were 16.8 per cent above December, 1940, and approximately 1 per cent above the sales for November, 1941. For the entire year of 1941, sales were approximately 75 per cent above 1940. These figures apply to industrial gears only. They do not include automotive or high-speed turbine drive gears.

OBITUARIES

Ernest S. Craig

ERNEST S. CRAIG, vice-president and assistant general manager of the Nicholson File Co., Providence, R. I., died on December 26, in his sixty-eighth year. Mr. Craig became connected with the Nicholson File Co. in 1894. He was made assistant to the president in 1911, and was elected secretary of the company in 1915. In 1917, he was elected a director and assistant general manager, and in 1939 was elected vice-president. Mr. Craig was widely known throughout the steel industry. A very able business man, Mr. Craig was respected by all his associates for his sound judgment and close attention to business. He had a kind and lovable disposition that won the deep respect and affection of all those who came in contact with him.

THOMAS H. MORCOM, factory superintendent of the General Railway Signal Co., Rochester, N. Y., in charge of the company's Lyell Ave. plant, died suddenly on January 11 at his home in Rochester, following a heart attack, aged fifty-seven years. Mr. Morcom was born in Jermyn, Pa., on February 20, 1885. He attended elementary school in Jermyn and high school in Rochester, N. Y. His first job was in the Lehigh Valley Machine Shop in Sayre, Pa.; later he was connected in turn with the Gleason Works and the Knowlton Machine Tool Co., both of Rochester. In 1912, he obtained a position with the General Railway Signal Co., working in the tool-room. During the first World War he was connected with the United States Naval Gun Factory at Rochester. In 1919, he returned to the General Railway Signal Co. and served successively as assistant production manager, assistant factory superintendent, and general factory superintendent. He is survived by his wife and one daughter, Mrs. Robert Zimmerman.

RICHARD T. WINGO, president of the Superior Machine & Engineering Co., Detroit, Mich., died on December 13.

COMING EVENTS

FEBRUARY 4-6—INDUSTRIAL RELATIONS AND PERSONNEL CONFERENCE sponsored by the American Management Association at the Hotel Stevens, Chicago, Ill. For further information, address the American Management Association, 330 W. 42nd St., New York City.

FEBRUARY 16-20—Mid-winter meeting of the NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION to be held in Chicago, Ill.

MARCH 2-6—Spring meeting and Committee Conferences of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Cleveland, Cleveland, Ohio. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

MARCH 12-13—Aeronautic Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Hotel New Yorker, New York City. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

MARCH 17-19—Annual convention of the AMERICAN RAILWAY ENGINEERING ASSOCIATION at the Palmer House, Chicago, Ill.

MARCH 23-25—Spring meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Houston, Tex. Secretary, C. E. Davies, 29 W. 39th St., New York City.

MARCH 26-28—Annual meeting of the AMERICAN SOCIETY OF TOOL ENGINEERS in St. Louis, Mo. Clyde L. Hause, secretary, 2567 W. Grand Blvd., Detroit, Mich.

APRIL 20-24—Forty-sixth annual convention of the AMERICAN FOUNDRYMEN'S ASSOCIATION, Cleveland, Ohio. For further information, address American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

Continued on page 188

MAY 31-JUNE 5—Semi-annual meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Greenbrier Hotel, White Sulphur Springs, W. Va. John A. C. Warner, secretary, 29 W. 39th St., New York City.

JUNE 8-10—Semi-annual meeting of AMERICAN SOCIETY OF MECHANICAL ENGINEERS in Cleveland, Ohio. Secretary, C. E. Davies, 29 W. 39th St., New York City.

JUNE 22-26—Forty-fifth annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary-treasurer, 260 S. Broad St., Philadelphia, Pa.

OCTOBER 12-16 — NATIONAL METAL CONGRESS AND EXPOSITION in Detroit, Mich., sponsored by the American Society for Metals. W. H. Eisenman, secretary, 7301 Euclid Ave., Cleveland.

NEW BOOKS AND PUBLICATIONS

PLASTICS CATALOG (1942). 624 pages, 9 by 12 inches. Published by the Plastics Catalogue Corporation, 122 E. 42nd St., New York City. Price, $5.

The new edition of the Plastics Catalog will be welcomed by designers who are studying applications of plastics in place of metals to meet the scarcity of metals created by war priorities. Like the first edition, it contains a wealth of information on every phase of the plastics industry. The book is divided into ten main sections. The defense section describes the application of plastics in the construction of equipment for air, land, and sea forces. It gives important information on the effect of priorities on the industry. The materials section, comprising almost 150 pages, covers every new development in this field. The plastics engineering section contains flow sheets showing the manufacturing procedure involved in producing each type of material.

The section on production operations discusses every aspect of this phase of the industry, including preforming, compression molding, injection molding, transfer molding, continuous dry and wet extrusion, casting phenolic resins, and all other types of operations. The machinery and equipment section shows all types of presses used in the plastics industry and all types of machines or equipment used in the manufacture or processing of plastics. The sections on laminates and vulcanized fibers, plastic coatings, and synthetic fibers and rubbers include the latest developments along these lines.

The plastics properties chart has been revised and amended, and the solvents and plasticizer charts have been brought up to date. The index and directory section has been expanded to almost three times its original size. It includes alphabetical lists of all molders, laminators, and fabricators, as well as the names and addresses of manufacturers; trade names; personnel and equipment; and a selected bibliography, as well as a list of technical institutions devoted to plastics.

PRACTICAL ARC WELDING. By W. J. Chaffee. 516 pages, 5 1/2 by 8 1/4 inches; 512 illustrations. Published by the Hobart Trade School, Inc., Troy, Ohio. Price, postpaid, $2.

In view of the importance of welding in war work, and the present demand for trained welders, this book is especially timely. The object of the book is to provide information on modern welding methods, with especial reference to the needs of educational institutions, vocational training schools, and government defense training activities. The book is divided into five parts. The first part contains general information on welding; the second and third parts comprise an operator's training course and contain the complete series of arc-welding lessons exactly as they are offered at the Hobart Trade School; Parts 4 and 5 contain a dictionary of welding terms and twenty pages of helpful tabular data for operators and designers. The material should be of value not only to the beginner, but also to the experienced welder.

PLANT PRODUCTION CONTROL. By C. A. Koepke. 509 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $4.

This book deals with the problems involved in planning for the production of goods in a modern factory, so as to obtain maximum production with the minimum confusion and expense. No one system of controlling the flow of work through the plant is advocated, but an attempt is made to resolve the problems into the functions necessary for controlling production in almost any situation.

The book is the outgrowth of a series of notes used in teaching, and is based on the author's experience obtained while working as a member of the regular industrial engineering staff in a number of plants and on a varied consulting practice in industrial centers. Fifteen different plants were studied as a basis for the text.

The material is divided into twenty-three chapters, covering such phases of the subject as an analysis of the factors that aid productivity; co-ordination of sales and manufacturing; scope of production control and its organization; production budgets; purchasing, inspection, and storing of materials; inventory control; plant capacity, depreciation, and machine replacement; methods and standards; planning and routing production; operation and instruction sheets; estimating production requirements and costs; transportation of materials; centralized control of production and the use of planning records; inspection; and measures of factory performance.

SIMPLE BLUEPRINT READING WITH SPECIAL REFERENCE TO WELDING. 146 pages, 5 1/2 by 8 1/2 inches; 96 drawings. Published by the Lincoln Electric Co., Cleveland, Ohio. Price, 50 cents per copy in the United States; 75 cents elsewhere.

This is the second edition of a book on blueprint reading that is especially intended for welders, but is of value, as well, to mechanics and others who wish to learn blueprint reading quickly. More than fifty drawings have been revised in the new edition, and eight new pages of drawings have been added. The text gives the student a clear understanding of the symbols used in drawing various types of welded joints, in addition to covering the essentials of general blueprint reading.

* * *

Paint for Concealment of Plants and Structures

A new type of low-visibility paint for use in the protective concealment of plants and structures has been developed by the Arco Co., Cleveland, Ohio. The new paint is already in use on some government properties. It meets the tentative Navy specifications for infra-red reflecting paints for use on fuel storage tanks, buildings, and certain types of equipment where dark colors, as well as heat reflecting qualities, are required. The paint is available commercially under the trade name "Infray," and is made in green, tan, black, and four intermediate shades. All seven shades are difficult to see from the air.